PHYSICAL SOCIETY EXHIBITION PREVIEW—*Pages 41 to 56*

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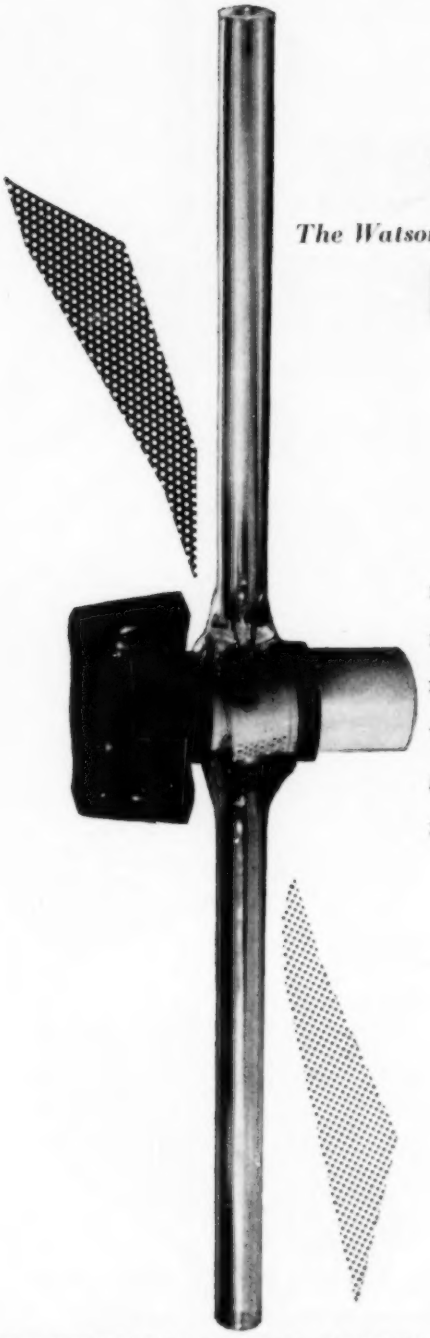

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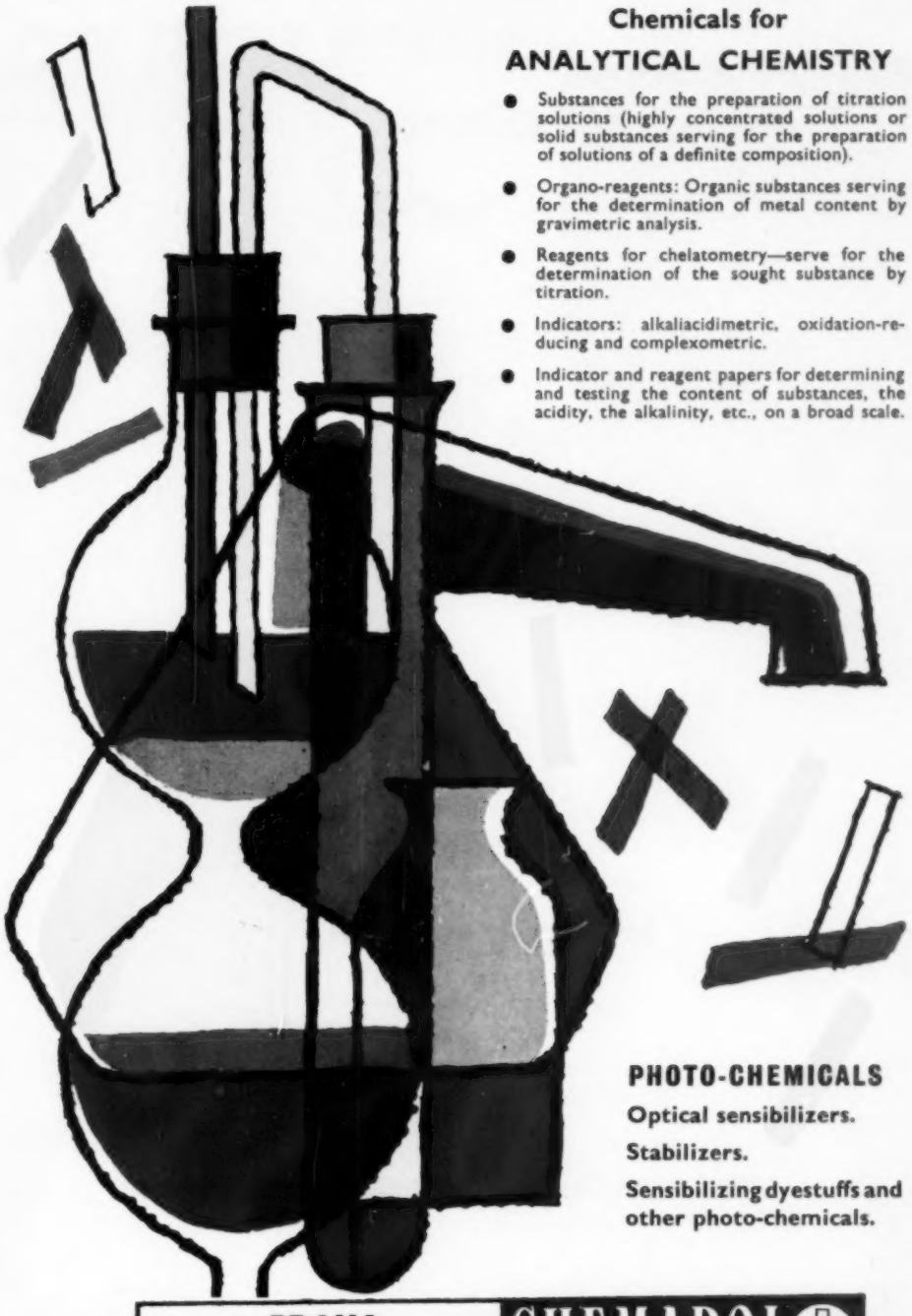

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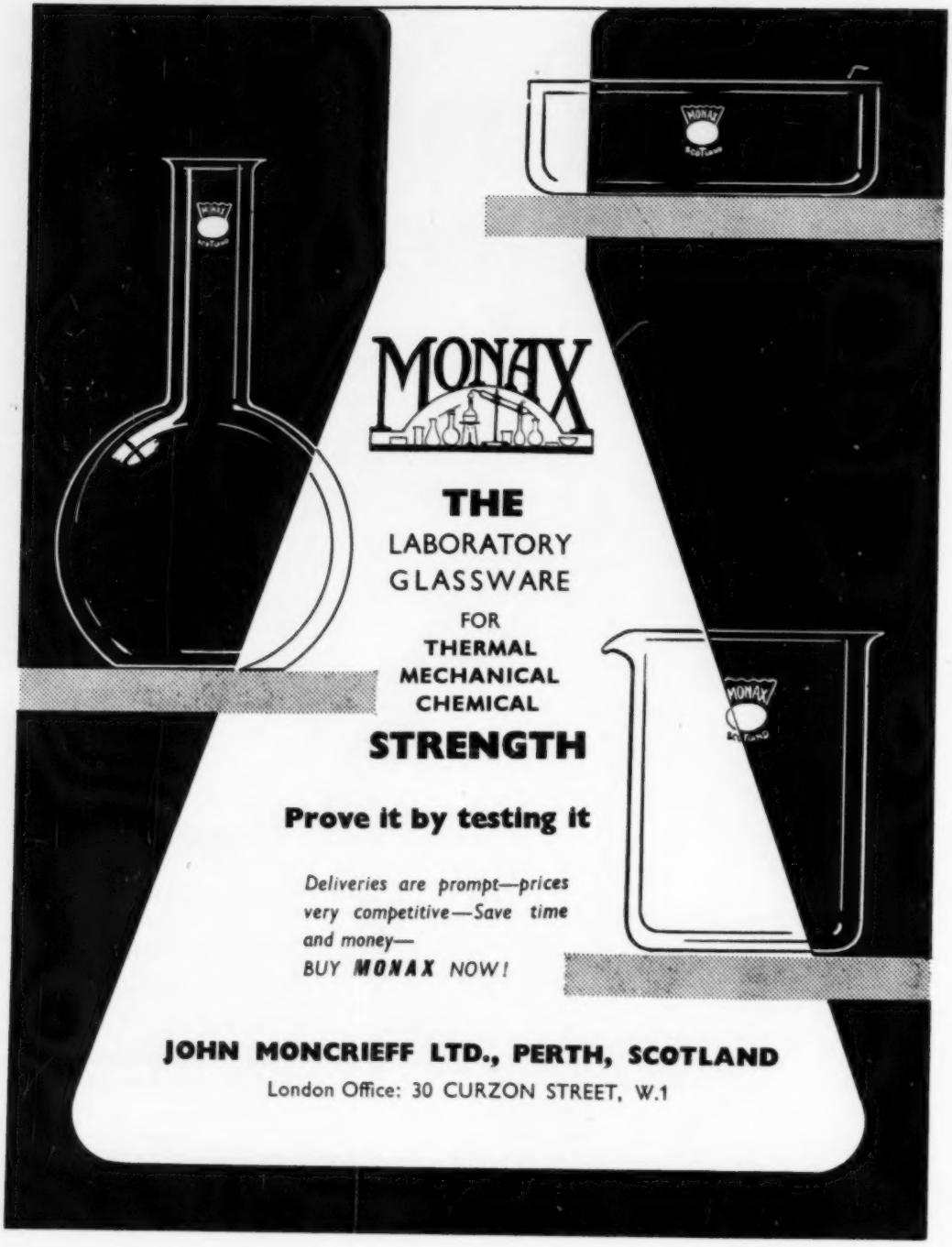
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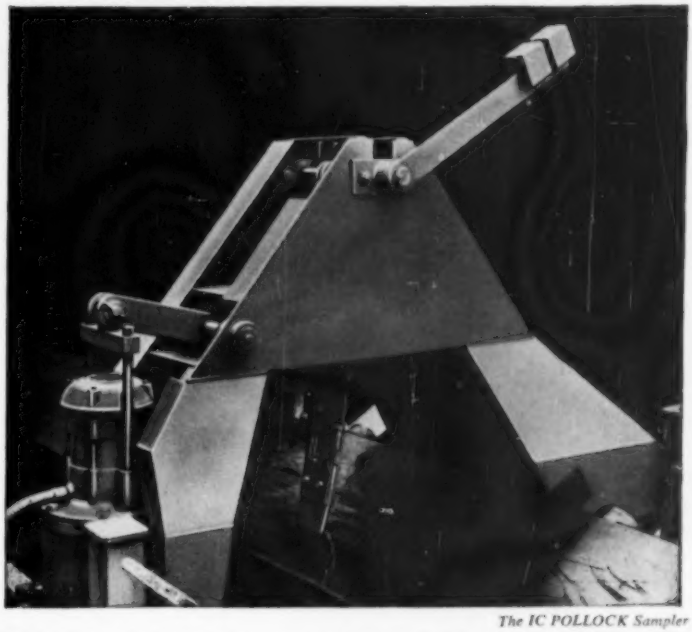

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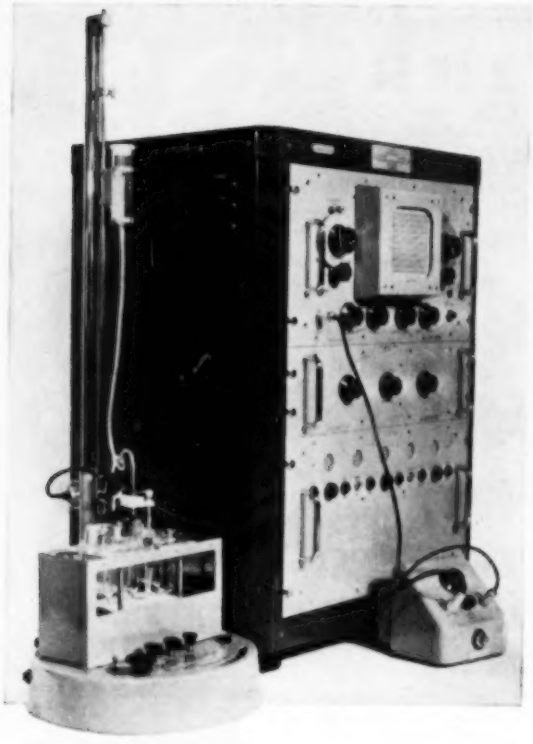

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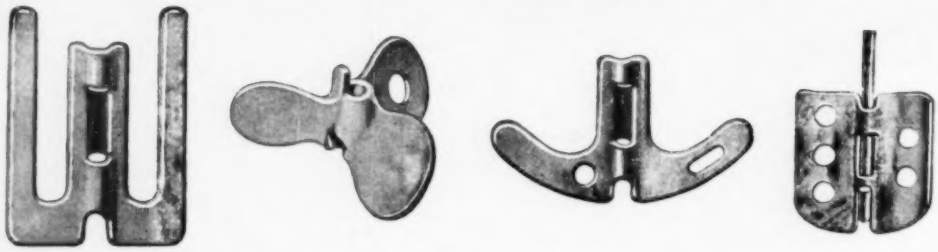

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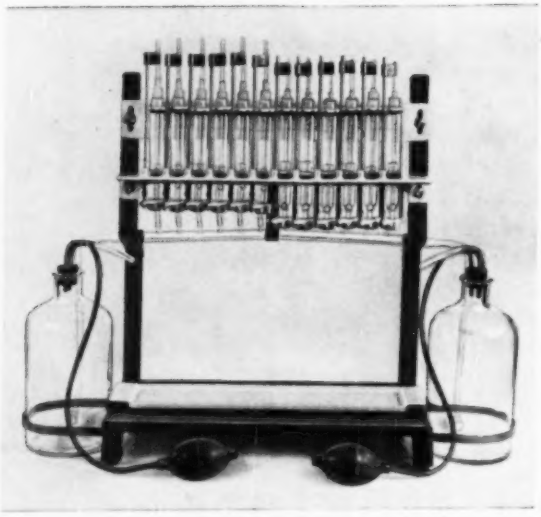

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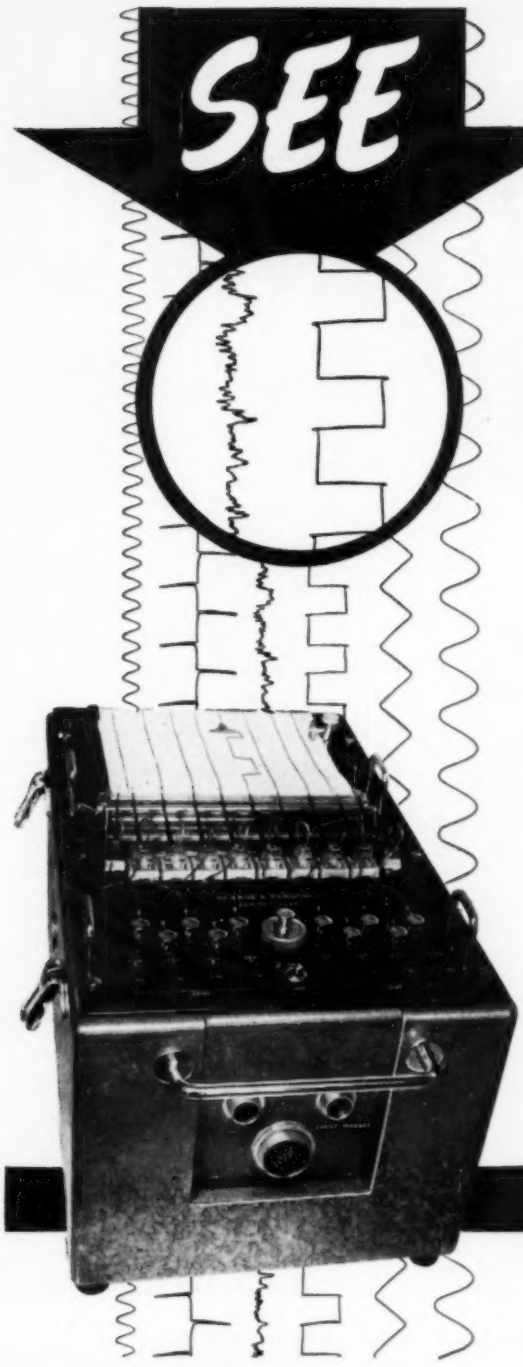

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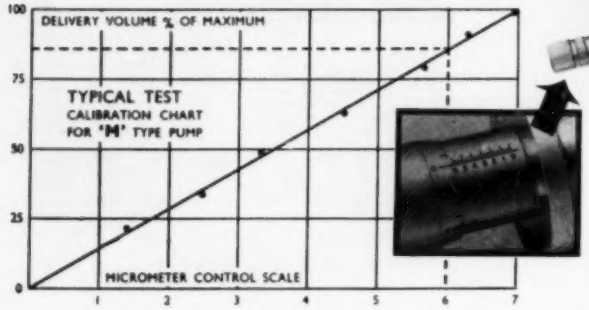

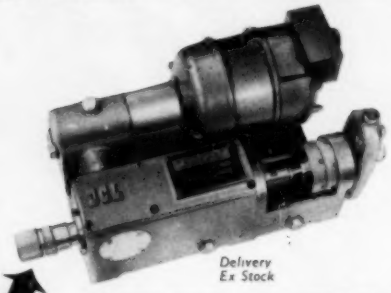

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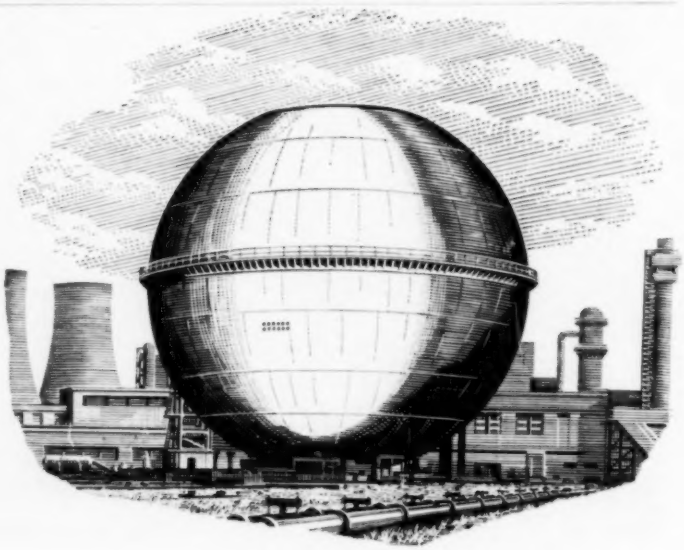

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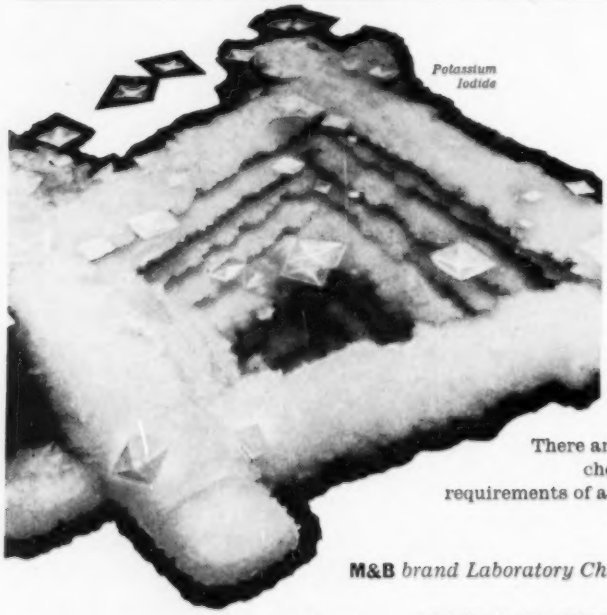

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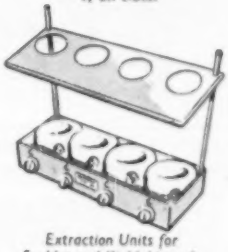

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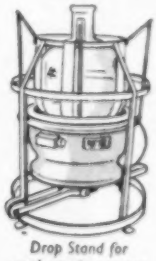

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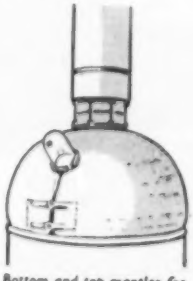

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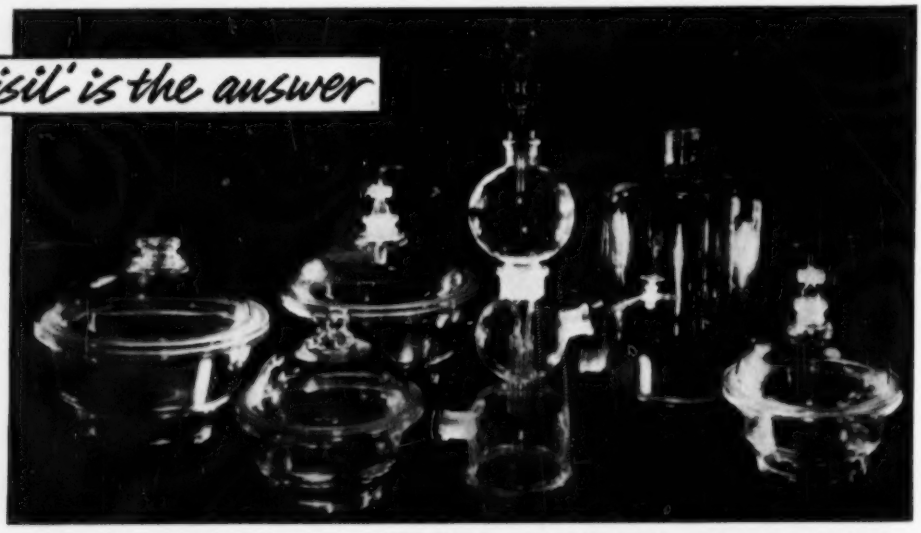

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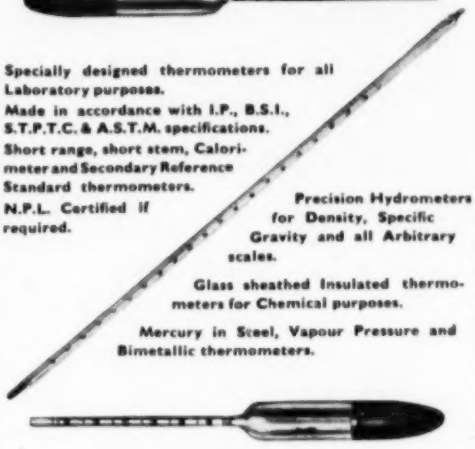

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LABORATORY PRACTICE

RESEARCH · CONTROL · TEACHING

Vol. 9 JANUARY 1960 No. 1

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SCIENTIFIC ADVISORY COMMITTEE

WE WELCOME three distinguished new members to our Scientific Advisory Committee: Prof. Sir Charles Dodds, M.V.O., D.Sc., M.D., F.R.C.P., F.R.S., Dr. G. I. Finch, M.B.E., D.Tech.Chem., F.Inst.P., F.R.S., and Prof. A. A. Miles, C.B.E., M.A., M.D., F.R.C.P.

Sir Charles Dodds

Sir Charles is Courtauld Professor of Biochemistry in the University of London at the Middlesex Hospital and Director of the Courtauld Institute of Biochemistry. He has been President of many societies and Vice-President of the Royal Society. The recipient of many medals and other honours, he is known internationally for his work on biochemical problems in relation to hormones and carcinogenic substances.

Dr. G. I. Finch

Dr. Finch is Professor Emeritus of Applied Physical Chemistry in the University of London, and was formerly Director of the National Chemical Laboratory of India. He has been President of the Physical Society and was a member of the 1922 Everest Expedition. He was Hughes Medallist of the Royal Society in 1944, and is known internationally for his work on the electron structure of metals.

Prof. A. A. Miles

Prof. Miles is Director of the Lister Institute of Preventive Medicine, London, and Professor of Experimental Pathology in the University of London. He was formerly Professor of Bacteriology at University College Hospital, and is a member of the Medical Research Council.

All three new members have published many classical papers and are authors of standard works in their subjects. They will greatly assist us in maintaining the scientific standard of our journal.

EDITORIAL

Some Courtesies for the New Year

MOST discourtesies in our everyday lives probably arise more from thoughtlessness rather than intentioned rudeness. We shall do ourselves no harm if we think for a moment on some of the most common of these.

The increasing pace of life has resulted in a tendency for business executives and others to scribble an undecipherable hieroglyphic at the end of their letters without having their name typed beneath it. Sometimes a mere equally undecipherable initial is penned above the typed name of the firm, an addition which cannot be regarded as very helpful. The alleged higher standard of education and the higher school-leaving age do not seem to have resulted in even maintaining the standard of handwriting. Such letters frequently carry the legend 'All communications must be addressed to the firm and not to individuals'. However, there are many occasions when some query arises and the recipient wishes to clarify the matter by personal contact. No matter how helpful the telephone operator may be, it often takes some time and effort to track down the writer of the letter. Quite apart from this unnecessary difficulty, it is preferable always to address a letter to an individual even if in a large firm the letter is answered by an assistant.

Another annoying and rather stupid practice when there are several offices is for a letter to be written from one office on a letter heading bearing only the address and telephone number of the chief office or laboratory. Time is then wasted in trying to contact the writer by telephone.

A frequent source of irritation is for a busy man to come into his office and find a message asking him to ring a certain number, with no other information. Even if the number is correct, should the company concerned happen to be a large one the resultant chasing round is stupid and unnecessary. Even with an office or laboratory having only a few seniors, the person who made the call may be not available. Incidentally when contacting a stranger it is always preferable to send a letter in the first instance so that the person approached knows exactly with whom he is dealing.

Obviously the telephone is a key utility in modern life, but we all managed somehow in the days before the telephone, the motor car, the aeroplane and even the railway were invented. The rush of things and the ever-increasing speed do not always lead to increased health and happiness. When time permits a letter has advantages, not the least of which is the fact that there is a permanent record of the matter.

A most discourteous act is to put through a call and then not to be available when the person called is put through. When he has been waiting five minutes while your secretary runs you to earth you are hardly likely to get a favourable response to your business proposals!

Finally we may offer a suggestion on public relations. In spite of all the publicity and talk on this aspect of business, it is amazing how often one phones a firm and has difficulty in contacting anyone who knows anything about the subject of the enquiry. A patient and conscientious telephone operator tries all the executives in turn, but sometimes without success. A simple system is to put all general enquiries through to a senior and experienced woman secretary who is made responsible for such calls. This simple method is often more effective than all the modern décor, long finger nails and exotic plants in the 'Reception'.

Techniques in Radiochemistry

A paper on 'Techniques in Radiochemistry for Analysis and Research' by D. A. Lambie, B.Sc., F.R.I.C., (U.K.A.E.A., The Radiochemical Centre, Amersham, Bucks.) was read at a joint meeting of the Scottish Section of the Society for Analytical Chemistry and the Glasgow and West of Scotland Section of the Royal Institute of Chemistry.

The basic principles of tracer and dilution methods were outlined and criteria suggested by which to judge when they could be employed with advantage.

Methods of detecting and measuring radioactive samples by autoradiography, beta and gamma counting of solid samples and solutions were described, emphasis was given to the practical aspects rather than the theoretical principles which were adequately covered in the literature.

The precautions required when conventional analytical techniques were applied to radioactive samples, and the suitability of the ordinary well appointed analytical laboratory for radioactive tracer and isotope dilution methods of analysis were discussed.

Typical examples of the application of tracer and dilution methods were examined.

Point-Source Gamma-Ray Standards

The National Bureau of Standards is making available for the first time point-source standards of radioactivity. These standards are gamma-ray emitters and will be useful to research workers in approximating 'ideal' conditions when calibrating scintillation counters and other beam-detecting devices.

Five of these standards are being issued under the Bureau's programme to supply standards in all areas of the physical sciences.* The five are sodium-22, zinc-65, niobium-95, strontium-85, and mercury-203. Each standard consists of radioactive material deposited between two layers of a thin polyester tape.

The activity of each of the nuclides distributed in this form is approximately 5×10^4 gamma rays per second. Sodium-22, which has a half-life of 2·6 years, emits a gamma-ray of 1·28 Mev. energy, an annihilation gamma ray of 0·511 Mev. energy, and X-radiation characteristic of neon. Zinc-65, with a 45-day half life, gives a 1·11-Mev. gamma ray, an annihilation gamma ray of 0·511 Mev, and X-rays characteristic of copper. Strontium-85 emits a gamma ray with an energy of 0·513 Mev. and X-radiation characteristic of rubidium. Its half-life is 65 days. Niobium-95, which has a half life of 35 days, emits a 0·768-Mev. gamma ray. Mercury-203 emits a 0·279-Mev. gamma ray and X-radiation characteristic of thallium. Mercury-203 has a half-life of 46·5 days.

*Further information is contained in Standard Materials, NBS Circular 552 (third edition), which may be obtained by writing to the Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. (35 cents).

ORIGINAL CONTRIBUTION

OBSERVATIONS ON THE EXAMINATION OF CASEIN PREPARATIONS BY PAPER ELECTROPHORESIS

by M. T. Sode-Mogensen and E. Lahav

Department of Dairy Chemistry and Bacteriology, The Royal Veterinary and Agricultural College of Denmark.

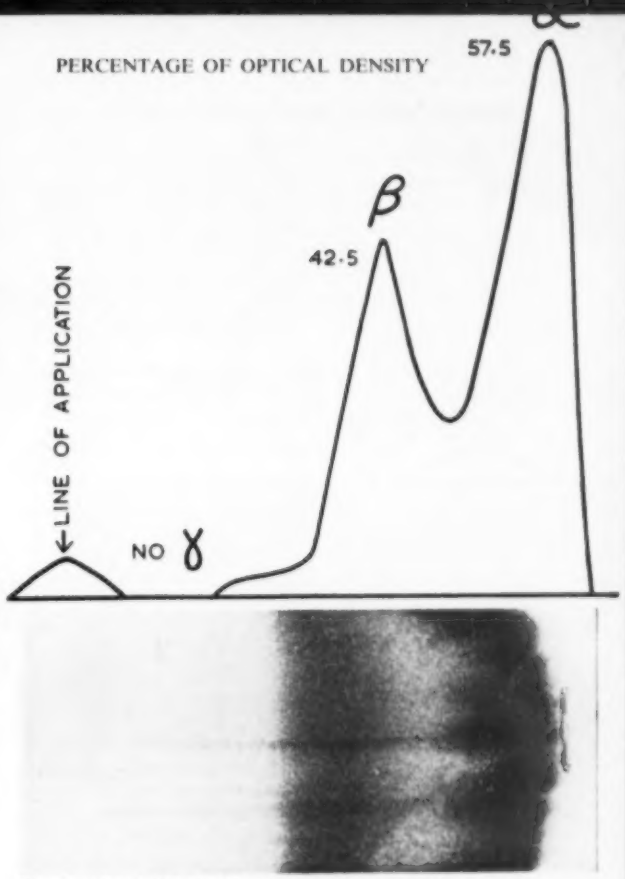


Fig. 1a (below). Wet casein. Only one precipitation with *N* HCl at pH 4.5 and four times washing with distilled water. All three components are present at the normal relative quantities: α - 60 per cent, β - 31 per cent and γ - casein 9 per cent.

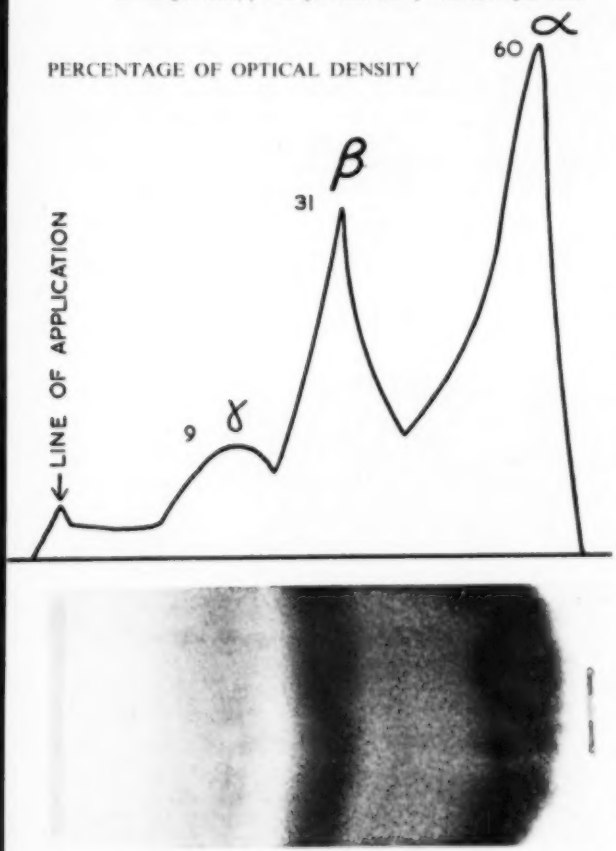


Fig. 1b (above). Wet casein treated after precipitation at pH 4.5, washing with water, redissolving in alkali and reprecipitating by acid (the classical Hammarsten method). Clear separation of α - casein and β - casein. The relative quantities of casein components are: α - 57.5 per cent, and β - casein 42.5 per cent—a normal percentage.

Introduction

Several papers have been published on the paper electrophoresis (PEP) of milk proteins, but only a few publications have been concerned specifically with casein[5].

Because of the increasing interest in the study of the composition of casein and especially the behaviour of the components with rennet, the applicability of PEP to pure casein systems has been studied. Experiments on this subject have recently been made in this laboratory and some of the observations are described below.

The purpose of our investigations was to develop a routine method for the examination of casein preparations by PEP. The effect of a number of factors had to be studied in order to obtain a satisfactory method. A study of the literature and preliminary experiments gave information which made it possible to establish good experimental conditions at an early stage of the investigation. The conditions were then varied to study the influence of the factor in question. The basic standard conditions were: A 5 per cent casein solution.

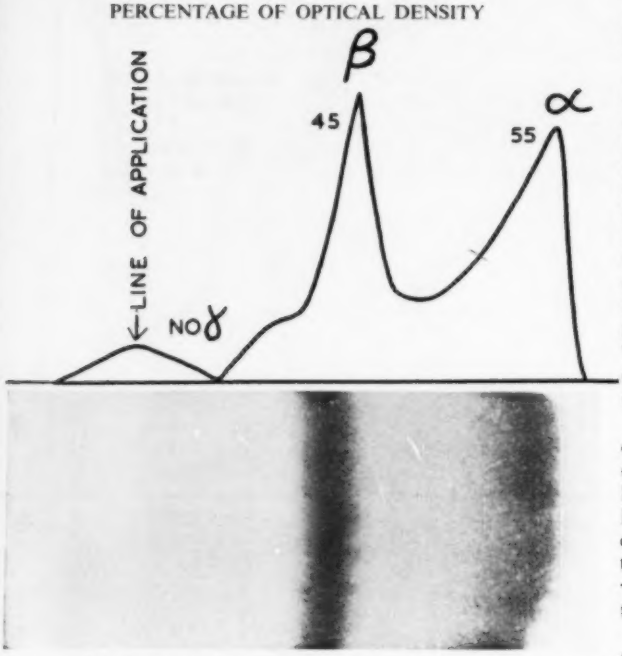


Fig. 2. Electrophorogram of casein according to Linderstrom-Lang's method, showing clear separation for α - and β - casein, but no γ - casein. Relative quantities are: α - casein 55 per cent, β - casein 45 per cent, γ - casein 0 per cent (abnormal percentages).

Electrolyte: veronal buffer pH 8 to 9. *Voltage gradient:* somewhat lower than 5 volts per cm. *Duration:* about 16 hours.

Preparation of Casein

Alkali treatment.—In the development of this method it is essential to separate casein from the other constituents of milk by a method which does not alter the proportions of the casein component system. Substances such as strong alcohol and strong alkalis must be avoided as they alter the casein system. Purification by the classical Hammarsten method[2,3] which calls for repeated alkaline dissolution followed by reprecipitation with acid might cause considerable irreversible denaturation and cannot be recommended. The casein is quite unstable in solution on the alkaline side of the isoelectric point and reprecipitated casein will not have the same ionic structure as natural casein.

The following experiment was made in order to elucidate this point. Fig. 1a shows the electrophorogram of a casein preparation without the use of alkali and Fig. 1b of casein prepared by alkali according to the Hammarsten procedure. The relative amount of each component is found by means of a planimeter assuming that the total area is hundred. It will be seen that the γ-casein has disappeared from the electrophorogram of the alkali-treated casein.

It is thus evident from the electrophorograms that an alternating treatment with acids and alkalis will cause alterations in the casein system.

Furthermore, the NaCl produced from addition of HCl and NaOH will tend to precipitate the γ-component.

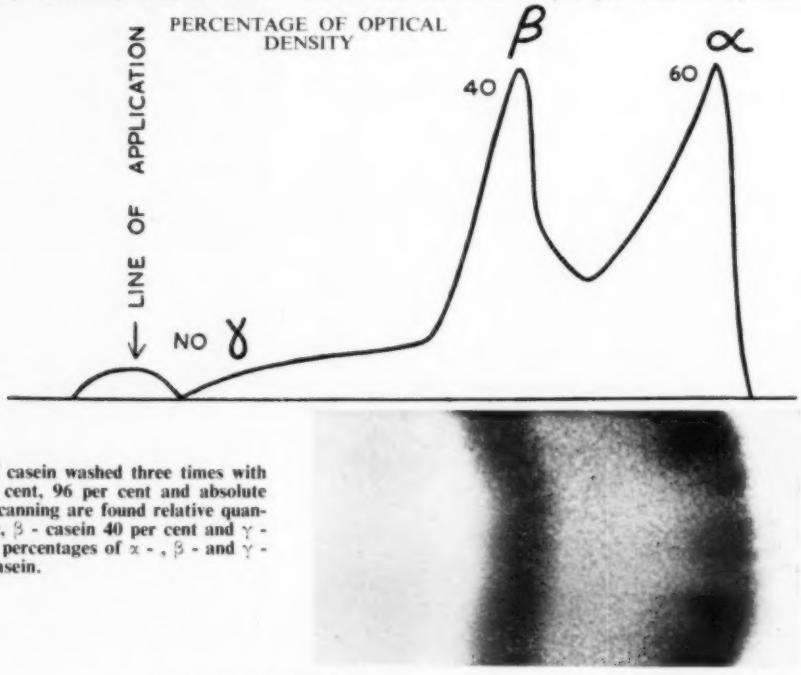


Fig. 3. Electrophorogram of casein washed three times with alcohol, respectively 50 per cent, 96 per cent and absolute alcohol and then dried. By scanning are found relative quantities: α - casein 60 per cent, β - casein 40 per cent and γ - casein 0 per cent. Abnormal percentages of α - , β - and γ - casein.

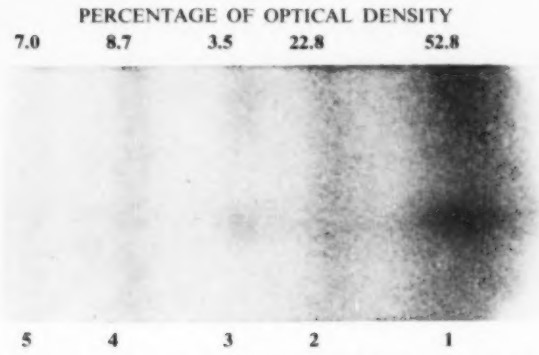


Fig. 4a. 1 per cent casein solution at pH 8.6. Casein dissociated into five or six components, some of which might be peptones.

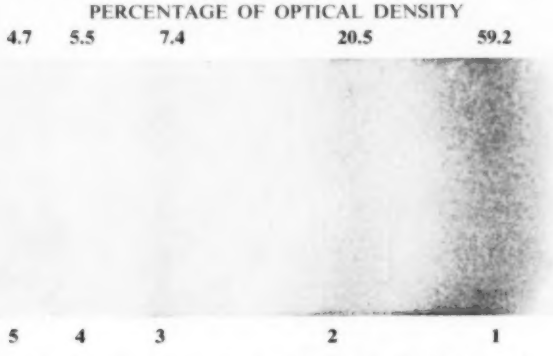


Fig. 4b. 2.5 per cent casein solution at pH 8.6. Casein dissociated into five components, some of which might be peptones.

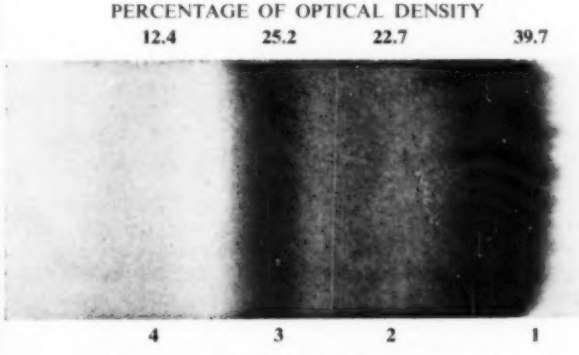


Fig. 4c. 5 per cent casein solution at pH 8.6. Casein dissociated into four components, some of which might be peptones.

Fig. 4d. (right). 10 per cent casein solution at pH 9.1. Casein dissociated into two components. The γ-casein seems to have the same mobility as the β-casein.

Such an alkali treatment should therefore be avoided.

Alcohol treatment.—The addition of alcohol as used by Linderstrøm-Lang[4] might change the casein component system resulting in the complete disappearance of the γ-casein component as shown in Fig. 2.

The drying of casein with alcohol after the precipitation should also be avoided, because the alcohol drying will cause denaturation of the casein[7] and the disappearance of the γ-casein from the electrophorogram. This is clearly shown in Fig. 3.

Precautions in the Preparation of the Casein Solution

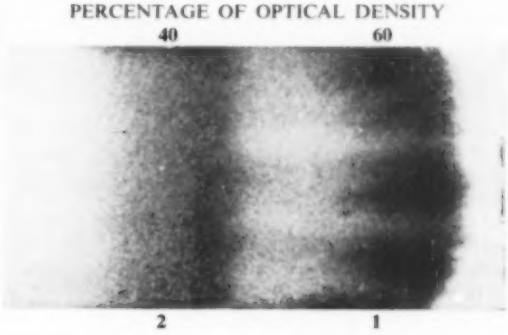
Effect of the concentration of casein.—To get a clear γ-zone in the electrophorogram wet casein should be used according to what has been presented above (Fig. 1a).

The stability of proteins in solutions is dependent on the concentration, the proteins being more stable in concentrated solutions than in weak solutions[8]. A series of PEP experiments with different casein concentrations were made in order to investigate the concentration characteristics. The casein preparation was six days old.

1, 2½, 5 and 10 per cent solutions were made up from this preparation and electrophorograms of the solutions were made. The experimental results are presented in Fig. 4a to 4d.

It is seen from the figures that more components are formed when the protein solution is weak than when it is strong; moreover it is apparent from the electrophorograms that the γ-component is less pronounced with increasing casein concentrations. The pH was 8·6 in all cases except the last (Fig. 4d) which was 9·1. It was impossible to make up a 10 per cent casein solution at pH 8.6, and so the higher value was chosen. The electrolyte solution had a pH of 8·6 in all four experiments. The fact that γ-casein has disappeared from the last electrophorogram might be explained by the higher mobility of γ-casein under these conditions. If the emphasis is on the separation of the α, β and γ components of casein the use of a 5 per cent casein solution seems to give good results.

Adjustment of the pH.—The correct adjustment of pH in the solution of casein is of the greatest importance as the α, β and γ caseins have different abilities to bind



PERCENTAGE OF OPTICAL DENSITY

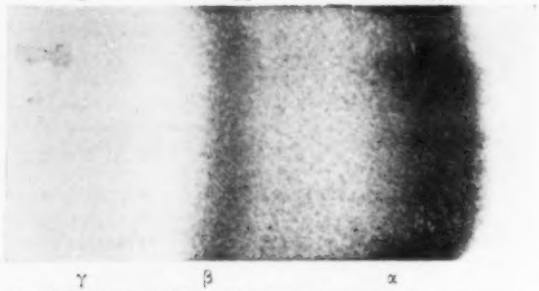
41.7 58.3

No γ β α

Fig. 5a. Casein solution pH value 9.0. Too high pH; the α-zone is split and γ-casein has disappeared.

PERCENTAGE OF OPTICAL DENSITY

9 31 60

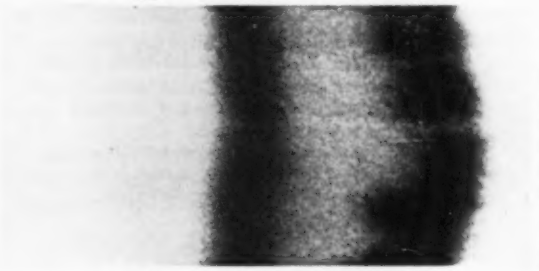


γ β α

Fig. 5b. Casein solution pH value 8.6. α-zone is more compact and γ-casein is present. Good result.

PERCENTAGE OF OPTICAL DENSITY

5.2 39.3 55.5



γ β α

Fig. 5c. Casein solution pH value 8.1. α-, β- and γ- components can be seen. Mobility of β-component is increasing.

PERCENTAGE OF OPTICAL DENSITY

43.03 56.97

No γ β α

Fig. 5d. Casein solution pH value 7.5. Increasing mobility of α- and β-components. Relatively greater increase of β-component. Therefore approaching of α- and β- components. γ-component has disappeared.

PERCENTAGE OF OPTICAL DENSITY

39.1 60.9

No γ β α

Fig. 5e. Casein solution pH value 6.6. Increasing mobility of α- and β-components. Relatively greater increase of β-component. Therefore approaching of α- and β-components. γ-component has disappeared.

alkali. McMeekin[6] reported the maximum combining capacity of α, β and γ casein as the number of grams of casein combining with one equivalent of base: α: 505, β: 666 and γ: 1042. This is due to the fact that the components of casein contain different amounts of phosphorus present as phosphoric acid and that phosphoric acid is the main base-combining group of casein.

It is of the greatest importance to have the right amount of base to dissolve the casein. If we use too much or too strong alkali, the base can alter the ionic structure of the casein and make the casein unstable. Decinormal NaOH was used to bring the wet casein into solution at the chosen pH. The electrolyte was in every case veronal buffer at pH 8·6 and the ionic strength 0·1. Fig. 5a to 5e shows electrophorograms of casein dissolved at different pH values.

The zone corresponding to the α casein is sharp at the front but ragged at the back except where a casein solution having pH 8·6 has been used. This electrophorogram also gives the best separation of α, β and γ caseins, and this is the reason why these conditions were chosen as standard. All the other conditions result in α casein zones which have a ragged back edge. This will cause an error when the dye-binding capacity is measured, and consequently we do not get a correct peak of α casein on the electrophorogram. At pH 9 the mobility of the γ casein will approach that of the β casein, which will cause the γ casein to disappear from the electrophorogram.

The influence of time during storage.—Even if the solution of casein is kept at 4° C. with the addition of toluene, some bacterial decomposition will probably

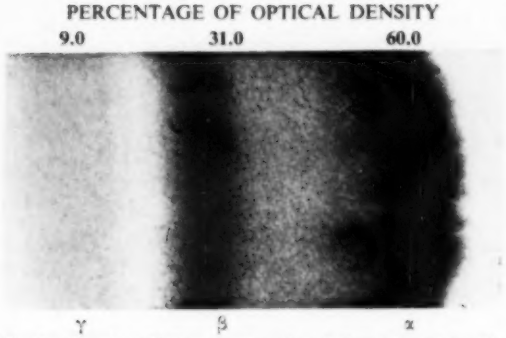


Fig. 6a. One day old 5 per cent casein solution. Normal result.

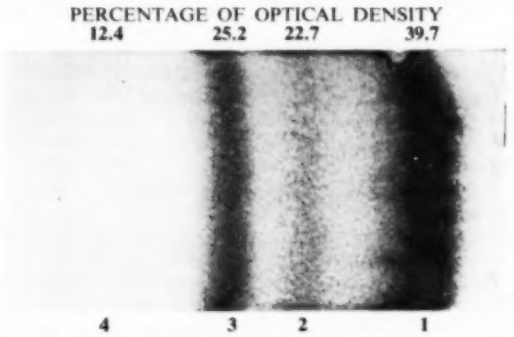


Fig. 6b. Six days old 5 per cent casein solution. Four zones present. Abnormal result (appearance of breakdown products).

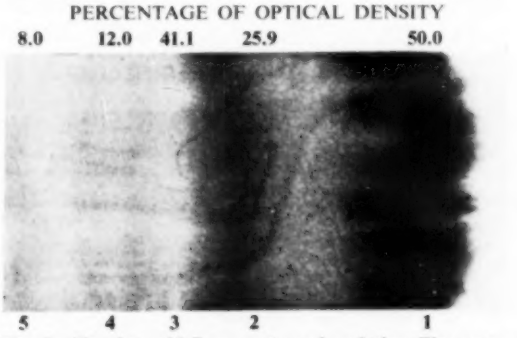


Fig. 6c. Ten days old 5 per cent casein solution. Five zones present. Abnormal result (appearance of breakdown products).

take place. Proteases may thus hydrolyse the casein to some extent resulting in lower molecular components, and on the electrophorogram several new zones will appear. Several workers have found five or six zones which were believed to represent genuine components, but these zones may have had their origin in hydrolytic products formed by enzyme activity. Fig. 6a, b and c show the influence of time on the proteolytic degradation of casein.

The decomposition products may be formed before the solution is six days old. From these experiments it is evident that in order to get a reliable electrophorogram the solution of casein should not be over three days old.

Choice of Buffer

Our experiments were made with veronal buffer as recommended by Baker[5] only with the modification of using a ionic strength of 0·1 instead of 0·05.

Influence of pH of the buffer.—Casein is amphoteric giving off as well as receiving hydrogen ions. At the isoelectric point (pH 4·6) its negatively and positively charged groups are balanced. At more alkaline pH values the casein becomes negatively charged owing to the dissociation of acidic groups and the protein will move towards the positive electrode. In selecting the pH value of the buffer we are faced with the problem of finding a value as far as possible from the isoelectric point in order to get the greatest possible mobility. We have chosen the pH values on the basic side of the isoelectric point as recommended by Tiselius[9], because negatively charged proteins are generally adsorbed on the filter paper to a lesser degree than positively charged proteins.

Experiments were performed, one at pH 8·6 and the other at pH 8·9. Fig. 7a and 7b show the electrophorograms of the two matched experiments. Unexpectedly it was found that the higher pH value resulted in a lower

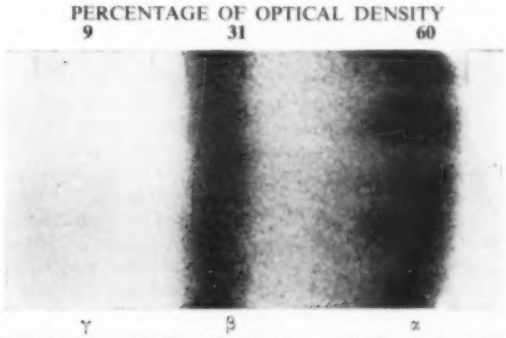


Fig. 7a. Veronal buffer pH = 8.6, μ = 0.1. Good separation and normal mobility.

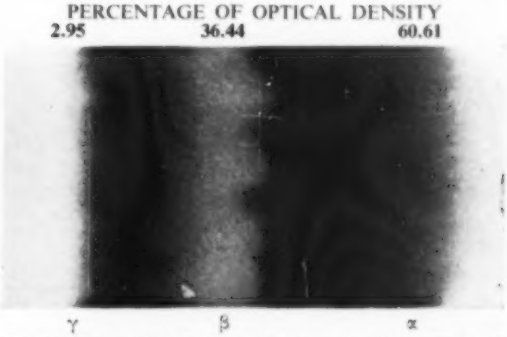


Fig. 7b. Veronal buffer pH = 8.9, μ = 0.1. Bad separation and decreasing mobility. α-component relatively decreasing and approaching β-component.

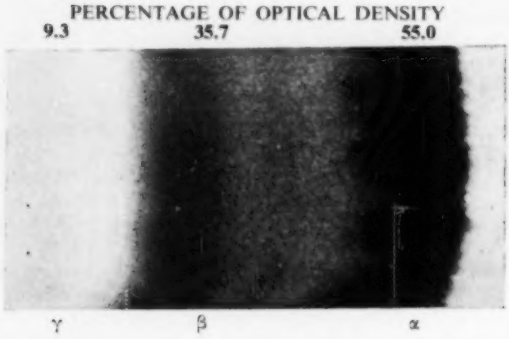


Fig. 8a. Wet casein. Veronal buffer pH 8.6. $\mu = 0.1$. Voltage gradient 4.7 volt/cm. Good separation of the three components.

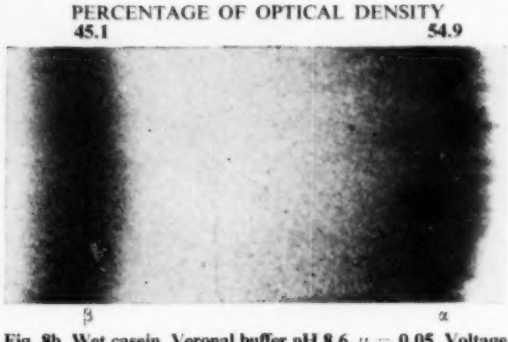


Fig. 8b. Wet casein, Veronal buffer pH 8.6. $\mu = 0.05$. Voltage gradient 4.7 volt/cm. Increasing of mobility. The γ-component has disappeared in the electrophoretic pattern

mobility. One of two theories or a combination of both might give the correct explanation of this phenomenon. During electrophoresis there will be a transport of water from one electrode chamber to the other. The velocity of this transport, like the true mobility of the ions, is a function of pH. The apparent mobility of the ions is the sum of the two velocities. The apparent ion mobility might for that reason have an optimum away from the isoelectric point and not show a steady increase. The other reason might be found in the ability of the casein to associate into components of higher molecular weight which will cause a decrease of its electrophoretic mobility.

As a consequence of these two experiments pH 8·6 was chosen as a standard as a good separation of α, β and γ caseins was obtained.

Influence of ionic strength.—The ionic strength has a very great influence on the mobility of the casein components. It is generally recommended to use low ionic strength ($\mu = 0.05$) in short time experiments (six to seven hours) which results in moderate currents (from 0·7 to 3·0 mA. per cm. width of the paper) even at a rather high voltage gradient (8 to 15 volts per cm.). A higher electrolyte concentration will, under these conditions, result in too strong a current and consequently too much water evaporation which will cause an increase of the electrolyte concentration. For long-time experiments (16 hours) and low current (0·25 mA. per cm. width) little disturbing evaporation will take place. These conditions are obtained when the ionic strength of the electrolyte is $\mu = 0.075$[1] and 4·7 volts per cm. is applied. Slightly higher ionic strength of the electrolyte is permissible and might be advantageous. Two matched experiments in which the ionic strength was varied is presented here (Fig. 8a and b).

The γ component is present in the electrophorogram at the highest ionic strength ($\mu = 0.1$) but seems to disappear in the experiment with the lowest ionic strength ($\mu = 0.05$). The casein preparation is the same in both cases, therefore the only possible explanation is that the γ component in the second experiment has the same mobility as the β component. It is interesting that scanning of the electrophorograms showed that the density of the β peak in Fig. 8b is equal to the sum of the densities of the γ and β peak in Fig. 8a, viz. 45·1 per cent against 45·0 per cent (35·7 + 9·3). No explanation for these findings will be offered here, but the importance of the choice of the proper ionic strength is emphasized. According to this experiment an ionic strength of 0·1 is to be recommended.

Remarks concerning veronal buffer.—Veronal is a good medium for some microorganisms. It is therefore necessary either always to use fresh buffer or to store it at low temperature. Addition of NaCl to the buffer

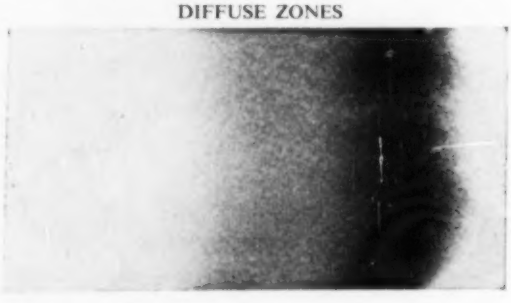


Fig. 9a. PEP carried out at 22°C. Poor separation.

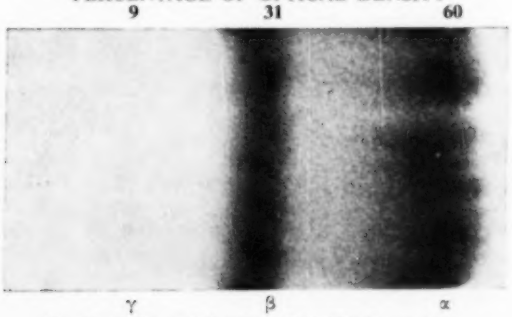


Fig. 9b. PEP carried out at 4° C. Good separation.

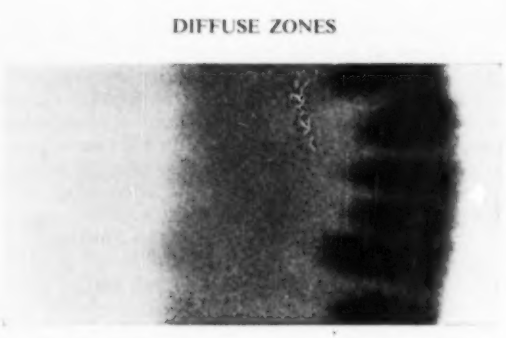


Fig. 10a. PEP carried out at constant strength of current 0.25 mA/cm. At the beginning of the operation: 2.47 volt/cm. At the end of the operation: 4.26 volt/cm. Unusable result.

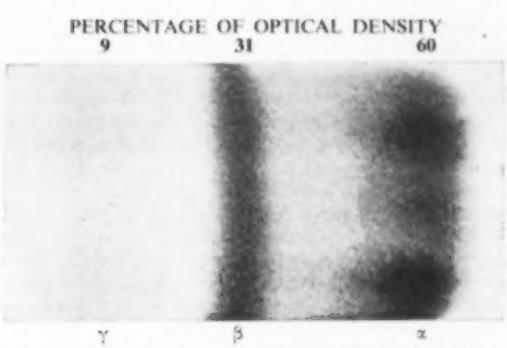


Fig. 10b. PEP carried out at constant voltage 4.70 volt/cm. At the beginning of the operation: 0.25 mA/cm. At the end of the operation: 0.30 mA/cm. Satisfactory result.

should be avoided because it is liable to precipitate the γ casein.

Temperature

Repeated experiments at room temperature and at 4°C. have been carried out in order to find which of the two temperatures gives the most suitable condition for the separation of α, β and γ casein. Fig. 9a and b prove that the low constant temperature of 4°C. is of fundamental importance for a good separation of the three casein components. One of the reasons why we have a good separation at 4°C. but not at 22°C. may be that the total affinity to the water phase of the casein system is greater at the lower temperature. The greater the hydrophilic affinity the easier the migration through the liquid phase.

Potential and Strength of Current

Electrophoresis on the same system was carried out in two identical apparatus, the one at constant current and the other at constant voltage. Fig. 10a and b show the corresponding electrophorograms. The experiments, which were repeated several times with the same result, demonstrated that constant current was much more suitable for the separation of the casein components than constant voltage.

Choice of Filter Paper

The coarseness and the thickness of the filter paper have an influence on the appearance of the electrophorogram. The coarse paper has little, but the fine paper, on account of the large surface of the fibres, has a greater adsorption capacity. In a thick paper the resistance to the current is smaller than in a thin paper. In order to find the most advantageous filter paper, experiments were made with filter paper Whatman 3MM, which is a coarse and thick paper, and with Sc. & Sch. 2043, which is a thin one and has a fine texture.

From the results shown on Fig. 11a and b it is concluded that thick and coarse filter paper is most advantageous for PEP on casein.

Quantity of Casein Application on the Paper

Several experiments with 5 per cent casein solutions (see p. 24 and 25) have shown that an application of from 2·5 to 3·8 mg. dry casein per cm. width of the paper gives the best results. This amount can be applied by means of the L.K.B. sample applicator using it five or six times for one application. The L.K.B. applicator was found to work very satisfactorily and better than a capillary tube as a constant flow was difficult to obtain from a capillary tube on account of pressure variations during the application.

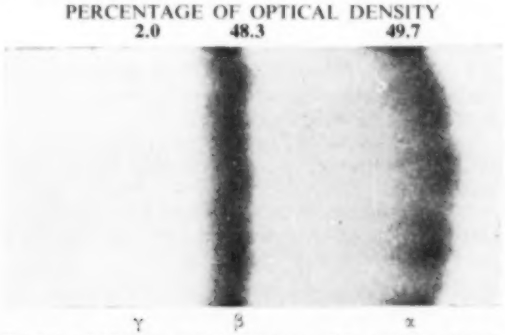


Fig. 11a. Schleicher and Schüll paper, thin and fine. Lower density of dye on account of greater adsorption.

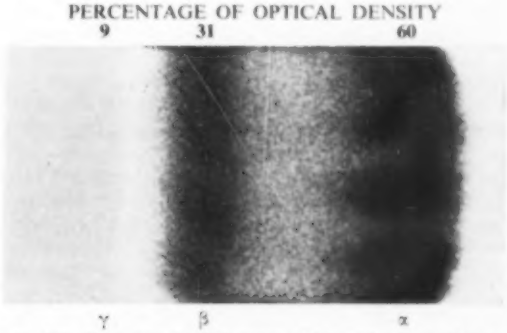


Fig. 11b. Whatman 3 MM paper, thick and coarse. Higher density of dye.

Apparatus

Experiments have been carried out with different apparatus: Elphor-H (German), Evans (EEL) (British) and L.K.B. 3276 (Swedish) all using the horizontal technique. They show that L.K.B. gives the best results with casein on account of the 'fakir' plexiglass support consisting of a plate equipped with tight rows of spikes. This arrangement will keep the paper exactly in a horizontal position, and this is of the greatest importance. If the paper sags, as in the Elphor and Evans apparatus, the hydrostatic forces will cause accumulation of liquid at the lower parts of the paper. This results in higher electric resistance and temperature, and increased evaporation in the upper parts of the paper. The water distilled off will be replaced by buffer and thus raise the conductivity of the upper parts[9] resulting in development of different voltage gradients along the paper strip, and so producing unreliable electrophorograms.

As the L.K.B. power supply is constructed neither for constant voltage nor constant current during the analysis, we have chosen the Stavolt (Struers) power supply, constructed by K. Brunfeldt, Nordisk Insulinlaboratorium, Copenhagen, as it gives a choice of either constant voltage or constant current during the operation. As has been discussed earlier, a constant voltage is advisable and a power supply made according to the principle of 'Stavolt' is therefore to be recommended.

Drying of Paper

After the completion of the electrophoresis the paper was dried at 110°C. for 30 min. in order to denature the casein and fix it on the paper. During the drying process the paper, should be kept horizontal to avoid the influence of hydrostatic forces. The heating in the oven should be uniform to get a regular distribution of the pattern.

It should be remembered that the cutting of the wet parts of the paper is of the greatest importance, because these parts contain considerably more liquid than the middle part, and therefore act as a reservoir during the drying process in the oven, which might result in flow of liquid.

Procedure Suggested

On the basis of the experiments described above we have chosen the following as a suitable procedure for the electrophoretic analysis of casein preparations by PEP.

Dissolving the casein.—A 5 per cent solution is made up of the casein to be examined. The casein may be available as a wet or a dry preparation. If a wet preparation is used the amount of moisture-free casein must be determined by the Kjeldahl method.

Casein solution made up from a 'wet' preparation.—Thirty g. of wet casein (roughly 5 g. moisture-free) is suspended in 20 ml. water, and 30 ml. of 0·1 N NaOH slowly added with stirring. Twenty ml. veronal buffer (pH 8·6) is then added making the solution up to 100 ml. 5 per cent casein. The pH was 8·6. Unless used immediately the solution is stored with toluene at 2°C.

Casein solution made up from a 'dry' preparation.—A homogeneous casein-water suspension is first made by thorough mixing of the casein and the water in a mortar. The calculated amount of base as 0·1 N NaOH is then slowly added with vigorous stirring. In order to dissolve the casein and bringing the solution to pH 8·6 there should be 0·6 milliequivalent NaOH to 1 g. of moisture-free casein. As it takes a long time for the base to penetrate into the casein it is necessary to keep the mixture standing for some hours with regular trituration. After the casein has been brought into solution it is necessary to remove small amount of impurities by centrifugation.

Electrophoretic and related operations.—Four strips of Whatman 3 MM 4 × 42·5 cm. are soaked in the veronal buffer (pH 8·6 μ = 0·1) and left hanging vertically for four minutes to allow excess liquid to drain off. The papers are then placed parallel with each other in the casette. After two hours for equilibration the sample solution is applied to the paper by the LKB sample applicator. Approximately 30 mm.^{3} of the 5 per cent casein solution is applied to each strip. Constant voltage is maintained at 4·7 volt/cm., giving a current of from 0·25 to 0·30 mA/cm. width, and the experiment run for 16 hours at a constant temperature of 4°C.

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The papers are treated for 10 min. with the Naphthalene Black 12 B 200 (Amido Schwartz 10 B) observing the precautions recommended by Baker[5]. Rinsing is carried out with a mixture of 45 per cent by weight CH_3OH, 45 per cent H_2O and 10 per cent CH_3COOH. Acidified rinses are preferred to tap water as they afford much sharper differentiation of the dye pattern. After rinsing, the strips are dried at room temperature (20° C.). The papers are made transparent by treatment for 30 min. with a mixture of alpha-bromonaphthalene and paraffin oil in the ratio 50:50 by weight. The air bubbles are displaced from the paper strips using a vacuum desiccator for 20 min.; they are then blotted to remove the excess of oil. The direct measurement of the electrophorogram is made by scanning with the Evans (EEL) densitometer using a green NO OGR 1 filter.

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Summary

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2. Wet preparations of casein are preferred to dry as chemical changes take place in the casein during drying with alcohol.

3. The influence of certain factors has been studied and a recommended procedure is described in detail in the last section of the paper.

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by John Paul, M.B., Ch.B., Ph.D., M.R.C.P. Edin.

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One of the most important of these has been the development of relatively simple media which will maintain rapid growth of many kinds of cells. These media are all based on simple mixtures of salts and glucose called balanced salt solutions (BSS). The most common of these are the ones devised by Hanks and Earle illustrated in Table I.

Almost all cells also require the addition of serum to the medium in concentrations varying from about 2 per cent up to about 30 per cent depending on the cells and the purpose for which they are to be used. Human, horse and calf sera are most commonly used, human serum being particularly desirable for growing certain human strains. Otherwise, calf serum (especially foetal calf serum) gives the best results. All samples of serum are potentially toxic to cell cultures and have to be tested before being used for routine work.

The fluid media used for growing cells contain, in addition to BSS and serum, sources of B vitamins and amino acids. In some media such as the well-known Morgan, Morton and Parker's medium 199 or Eagle's medium, these form part of a synthetic mixture. In other cases natural products such as lactalbumin hydrolysate or peptone are used as sources of amino acids and yeast extract is used as a source of vitamins. Thus a commonly employed medium for routine virology work contains 0·5 per cent lactalbumin hydrolysate, 0·1 per cent yeast extract and 5 per cent serum.

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$MgCl_2.6H_2O$		0·10
$NaH_2PO_4.H_2O$	0·125	
$Na_2HPO_4.2H_2O$		0·06
KH_2PO_4		0·06
Glucose	1·00	1·00
Phenol Red	0·05	0·02
$NaHCO_3$	2·20	0·35
Gas phase	5 % CO_2 in air	Air

BRIEF SCIENTIFIC BIOGRAPHY OF AUTHOR

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$NaH_2PO_4.H_2O$	0·125	
$Na_2HPO_4.2H_2O$		0·06
KH_2PO_4		0·06
Glucose	1·00	1·00
Phenol Red	0·05	0·02
$NaHCO_3$	2·20	0·35
Gas phase	5 % CO_2 in air	Air

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A highly specialized variant of this method is called organ culture, the object of which is to maintain the tissue in as normal a state as possible in culture conditions. It is used entirely in research work.

Disaggregation Techniques

One of the most important advances of recent years has been the discovery that certain embryonic and adult tissues can be treated with trypsin to produce disruption of the tissue without destruction of cells. In this way, suspensions of viable cells can readily be obtained. Tissues which have a great deal of fibrous tissue prove rather refractory to this treatment but other tissues are easily disaggregated. The technique is used very commonly in preparing cultures for virus assays. Monkey kidney and human amnion tissue are most commonly used for this purpose.

The trypsinization of monkey kidney tissue is performed as follows. Kidneys are obtained aseptically either immediately after death or by nephrectomy under anaesthesia before the animal is killed. The capsule of the kidney is removed and the pelvis (central region) is also dissected away leaving mainly cortical tissue. This is then chopped up in a balanced salt solution until it consists almost entirely of small pieces no more than 5 to 10 cubic millimetres in size. At this stage the BSS is decanted off and the fragments are resuspended in a quantity of pre-warmed trypsin solution (containing 0·5 per cent of trypsin in a phosphate buffer at pH 7·8). This is transferred to a conical flask containing a silicone-covered magnet. The flask is then placed over a magnetic stirrer and allowed to stir slowly. After a short time the supernatant fluid becomes cloudy with debris and free cells. The first harvest is decanted off and discarded as it contains growth-inhibitory substances. The fluid removed is replaced with fresh trypsin solution and the flask is left to stir for another 20 minutes. This time the supernatant, cloudy with suspended cells, is decanted into sterile centrifuge tubes. This process is repeated until several harvests have been gathered and only fibrous material is left in the flask. The cell suspensions are then spun down at about 1,000 g. for five minutes. The trypsin is discarded and the cells are re-suspended in a growth medium of the kind described earlier. Finally, the cell suspension is inoculated into flasks or bottles and incubated at 37° C. The cells settle to the bottom and spread out on the glass to form a fine even layer. Trypsinization of other tissues is carried out similarly.

Cultures prepared in this way are subsequently handled in the same way as cell strains.

Cell Strains

Some tissue cultures if fed regularly continue to multiply and proliferate indefinitely. Periodically the cells can be suspended by treatment with trypsin and reinoculated

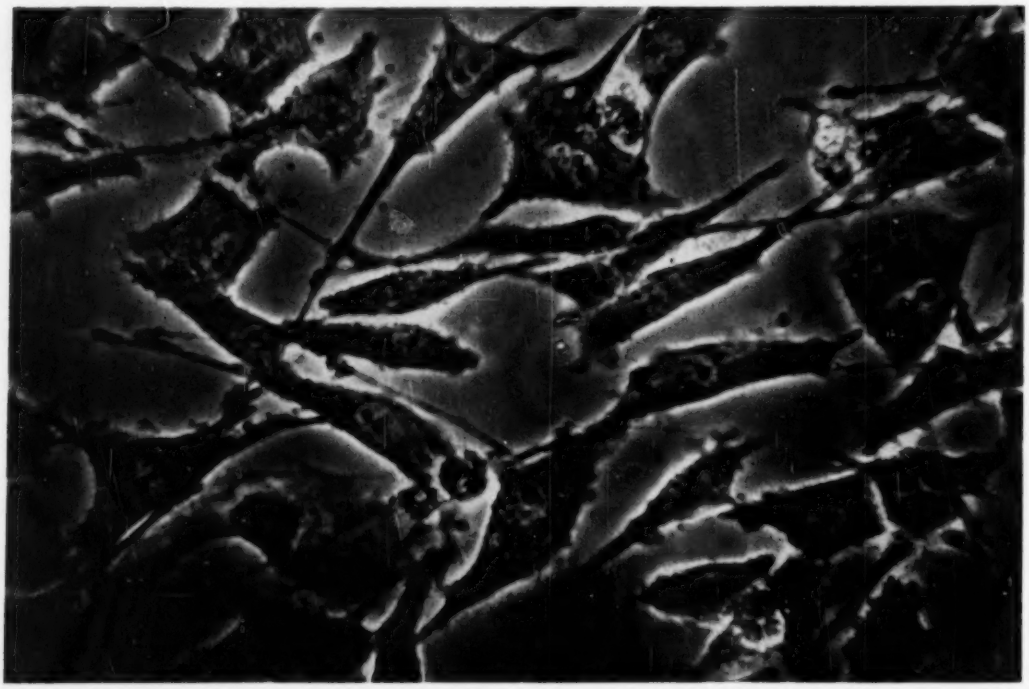

Fig. 1. A photomicrograph of some cells from a strain which has been maintained continuously for over ten years (phase contrast ×200.)

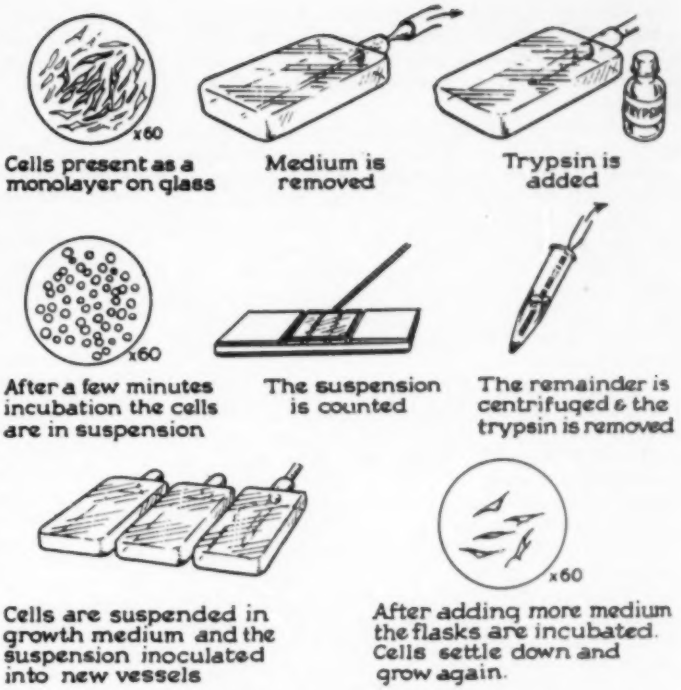
x60
Cells present as a monolayer on glass
Medium is removed
Trypsin is added
x60
After a few minutes incubation the cells are in suspension
The suspension is counted
The remainder is centrifuged & the trypsin is removed
Cells are suspended in growth medium and the suspension inoculated into new vessels
x60
After adding more medium the flasks are incubated. Cells settle down and grow again.

Fig. 2. Routine system for subculture of cells.

into fresh culture medium. They can be transferred serially for periods of many years. Cells which have become established in this way are called cell strains and they are used very widely both in virology and pharmacology. One of the cell strains most commonly used in virology is the HeLa strain. It is a culture of human cancer cells of epithelial type and the majority of cells used for virology are of a similar nature. In pharmacology the strain L cell which is a fibroblastic type originally derived from a mouse, is sometimes used for determining the general cytotoxicity of drugs. In other cases, an attempt is made to compare the action of drugs on strains derived from normal tissue on the one hand and cancer tissue on the other.

Stationary Cell Cultures

Cell strains may be grown in several ways but by far the commonest is directly on the bottom of glass vessels to which they readily adhere in much the same manner as amoebae (Fig. 1). The cells are seeded very thinly at first and multiply to form a compact layer which, however, rarely grows more than one cell thick. Types of glass vessels used for this purpose range from specialized flasks to ordinary medical prescription bottles.

In the management of cultures growing on glass, a common procedure is to transfer the cells once a week and feed on the fourth day after transfer. These operations are performed as follows.

Transfer of cell cultures.—Transfer of cell cultures (Fig. 2) is managed by preparing a suspension of cells and inoculating this into suitable culture vessels. Cells are obtained in suspension by treating the culture with a proteolytic enzyme, usually trypsin, or a chelating agent, such as ethylene-diamine-tetra-acetic acid (also called EDTA, sequestrene or versene). Trypsin is used for cells of fibroblastic type and also for cells or epithelial type. On the other hand, while EDTA is useful for cells of epithelial type, it is not so satisfactory for cells of fibroblastic type.

Trypsin treatment is carried out as follows. After the medium has been removed and the cells washed with BSS, the cell layer is covered with a solution of trypsin in BSS or phosphate buffer. This is allowed to incubate for about 10 minutes by which time the cells are seen to be coming off the glass. A little gentle agitation is usually adequate to remove them completely at this stage. The suspension is sucked up and down once or twice in a pipette to break up clumps. It is then transferred to a centrifuge tube and spun down fairly slowly (about 1,000 r.p.m. for three or four minutes). This is sufficient to sediment the cells. The supernatant trypsin solution is then discarded and replaced with medium. The cells are re-suspended in this by sucking them up and down once or twice with a pipette and are then ready to be inoculated into new vessels. Before doing so it is desirable to make an estimate of the cell numbers. With experience this can be done roughly by judging the size of the pellet of precipitated cells. But if a more accurate estimate is required, they are counted in a haemocytometer chamber or with an automatic cell counter using exactly the same technique as for blood cells.

The size of the inoculum depends on the size of vessel inoculated and the purpose for which the cells are to be used. For routine maintenance purposes, it is usually satisfactory to inoculate cells at a concentration of 50,000 to 100,000 per ml. medium. They will then increase about tenfold in the course of a week. Sometimes it is desirable to inoculate with even higher concentrations of cells in which case a maximum population is reached sooner. If very rapid growth is desired and it is known that the cell strain can be inoculated in very dilute suspension then very much lower inocula may be used and the cells may multiply from 50 to 100 times in the course of a week.

Feeding cultures.—To feed cultures it is merely necessary to remove all the medium and replace it with

fresh medium. If a very dilute inoculum has been used it may not be necessary to feed between transfers. With a few cell types it is sometimes desirable to replace only part of the medium rather than the whole medium at one time.

Preparation of replicate cultures.—For many experimental purposes it is desirable to prepare replicate cultures, i.e. cultures with exactly the same number of cells in each. The principles involved are the same as in the transfer of cultures. Cells are suspended as before and the numbers estimated. The cell suspension is diluted so as to give a suitable concentration and then inoculated into test vessels (usually test-tubes) by means or an ordinary pipette. Frequently an automatic dispensing device such as the Cornwall syringe is used for this purpose.

Cloning techniques.—For some experimental purposes it is necessary to grow colonies from single cells. This is done either in order to estimate the plating efficiency of cells or else to produce strains from single cells. Two techniques are used, the dilution technique and the isolation technique. In the dilution technique a suspension of cells is prepared as if for transfer and the number of cells present in it is estimated. It is then serially diluted in medium until a suspension containing 100 to 200 cells in 5 ml. has been obtained. 5 ml. of this suspension are inoculated into a 50 mm. Petri dish and this is placed in a special incubator which is continually gassed with 5 per cent of carbon dioxide in humidified air (to maintain the correct pH). When the dishes are left completely undisturbed for about ten days it is found that single cells have settled down and grown into colonies. The plating efficiency is expressed as the percentage of cells inoculated that has given rise to colonies. This technique demands considerable care in handling the cells. They must not be damaged by excessive alkalinity or by excessive handling and they must be placed in a particularly rich medium.

Despite all possible precautions it is apparent that one can never guarantee that a given colony has arisen from a single cell and not from a clump of two or more cells. When it is necessary to ensure that a colony has arisen from one cell the isolation method is used. In this technique a drop of a fine cell suspension is placed in the middle of a Petri dish. Some drops of medium are placed near this drop and they are covered with a thick layer of paraffin oil. Using a dissecting microscope and a micro-pipette a single cell is then picked up from the cell suspension and transferred to one of the drops of medium. Individual cells can be seen to grow into colonies. This technique requires some practice but is not too difficult to perform.

Suspension Cultures

For some purposes it is desirable to grow cells in suspension rather than directly on the surface of a glass vessel, and this can be fairly readily achieved. Some cells, particularly of lymphatic type, will grow spontaneously in suspension and will never adhere to glass. The majority of cells, however, tend to adhere rather readily to glass and in order to keep them in suspension it is necessary to agitate the growth medium vigorously by means of a stirrer.

Storage of Cells

Now that many cell types are available and in routine use, one of the problems in many laboratories is that of maintenance. Continuous transfer of several strains can become a very considerable undertaking and very wasteful if not all are required simultaneously. Fortunately, it has been found that cells can be fairly readily preserved by freezing. The technique is based on that which has been developed for preserving other kinds of cells. The cells must first be obtained in a very healthy growing state and protected by adding glycerol to the medium shortly before freezing. They are then cooled to a very low temperature (−70° C. or lower). When required they are thawed rather quickly, placed in fresh medium and incubated. After many months and even years of storage 80 to 90 per cent of the cells may survive this treatment.

Applications of Cell Culture Techniques

Two of the commonest routine applications of cell culture are in virology and pharmacology.

In virology replicate cultures, generally of trypsinized kidney or a cell-strain such as HeLa, are used for the isolation and identification of disease viruses and, by measuring protection against known viruses, for the titration of antibodies in the serum. They are also, of course, widely used in virology research.

In pharmacology cell-strains are used either to obtain an estimate of the cytotoxicity of new drugs before testing them on animals or to determine selective toxicity on cancer cells in the search for anti-cancer drugs.

The technique is rapidly finding other practical applications. Of particular interest recently has been its use in the study of human cytogenetics. The chromosomes of cultured cells are very easily observed and it has been possible by this means to establish with certainty the normal human complement. It has also been found that certain human abnormalities are due to abnormalities of the chromosomes, and that these can be fairly easily recognized using simple culture methods.

Besides these practical applications, the new techniques are being more and more widely applied in medical and biological research.

They are being used particularly in biochemical radiobiological and cancer investigations, but there is practically no field of biological research in which they have not found some application and it seems certain that with the conquest of the technical difficulties the culture of animal cells will become almost as common as the culture of bacteria.

REFERENCES

Paul, J. (1959). Cell and Tissue Culture. E. & S. Livingstone, Edinburgh and London.

DESIGN OF GLASS OIL—VAPOUR VACUUM PUMPS

by N. A. Florescu, D. Phys.

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Summary

The experimental result that a lower pressure is obtained when the choke tube of an ejector jet is not cooled was embodied in the design of an oil-vapour pump. The operating characteristics as well as the performance of a three stage pump made of glass are given.

Introduction

Development of the vapour pump to overcome the deficiencies of the driving liquid has to be carried out concomitantly with improvements in design in accordance with the theoretical requirements. Such work has been undertaken on oil vapour pumps in recent years in view of obtaining lower pressures. So far there have already been reported improvements obtained with commercial metal vapour pumps. However, lack of systematic investigation led to some fallacious conclusions.

The works referred to are concerned with designs of pumps capable of purifying, or degassing, their working fluid. The idea is not new. In the old pumps, however, the process of oil fractionation was poor, or not applied at all so that the impurities consisting of gases and light volatile components could not effectively be prevented from reaching the high vacuum jet. Improved oil fractionating either by proper isolation of the oil in separate compartments (Hickman, 1936; Lockenvitz, 1937) or boilers (Hickman, 1936) which feed the nozzles, by isolating the impurities by means of the process of molecular distillation which continuously takes place at the forepressure stage (Latham *et al*, 1951) or simply by tapping the more volatile components of the oil in a catchment placed in the forepressure line (Hickman, 1936), was successful in improving the performance of the vapour pump. From the experimental result that much lower ultimate pressures are obtained with multistage metal vapour pumps, if the cooling of the ejector stage is omitted (Latham *et al*, 1951; Bächler and Nöller, 1957), it was concluded that the pumps become more efficient in ejecting the impurities in the form of gases and volatile components into the forepressure line. However, the fact that the conditions of pump operation were changed by this alteration was ignored. Therefore, a different ultimate pressure is to be expected, even if the condition of the oil has not been affected.

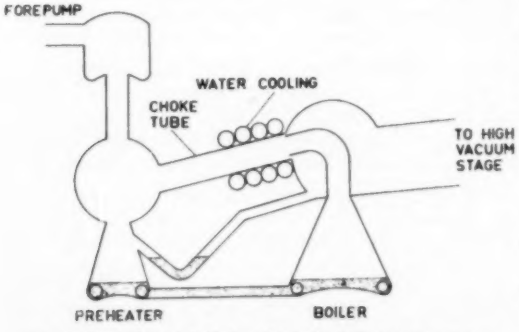

Fig. 1. Experimental design of an ejector vapour pump.

The purpose of this paper is to provide experimental evidence that the performance of the ejector stage is appreciably affected by cooling. This result was applied in the design of a self-fractionating oil vapour pump.

Experimental Results

Fig. 1 shows schematically an experimental single stage vapour pump of the ejector type made of glass. The ejector jet could be cooled by circulating tap water through rubber tubing wrapped around the choke tube covering a 35 mm. length of the vapour jet. When this tubing was moved to the other end of the choke tube the vapour streamed through the hot casing. For the purpose of the experiment a preheater consisting of a bulb with an immersed heating coil, similar to the boiler, was included in the forepressure line. The condensed vapour collected in this preheater, and from here could be returned either hot or cold to the boiler.

The oil in the preheater was maintained in purified condition when the temperature was near the boiling point, and therefore uncontaminated oil returned to the boiler. This process was not affected whether the vapour blast after leaving the nozzle was cooled or not. However, when the choke tube remained uncooled a lower pressure (Fig. 2, curve 1) was measured than when cooled (curve 2). The curves give the variation of the total pressure as a function of the boiler power input. An increase in pressure resulted by cooling the choke tube, particularly at smaller power inputs. A similar result was obtained when the heater was maintained cold, but obviously the pressures were higher, as in this case contaminated oil returned to the boiler. Even lower pressures resulted when heat losses were reduced by proper insulation of the choke tube.

Thus two independent processes occurring during the operation of the ejector jet appreciably affect the ultimate pressure: (i) the gas contamination in the oil which returns to the boiler, and (ii) the backward escape of gas along the walls when the choke tube is cooled.

By adding a high vacuum stage lower pressures are obtained. However, the ultimate pressure is affected by these processes which take place at the ejector stage. Therefore, an improved multistage pump design would

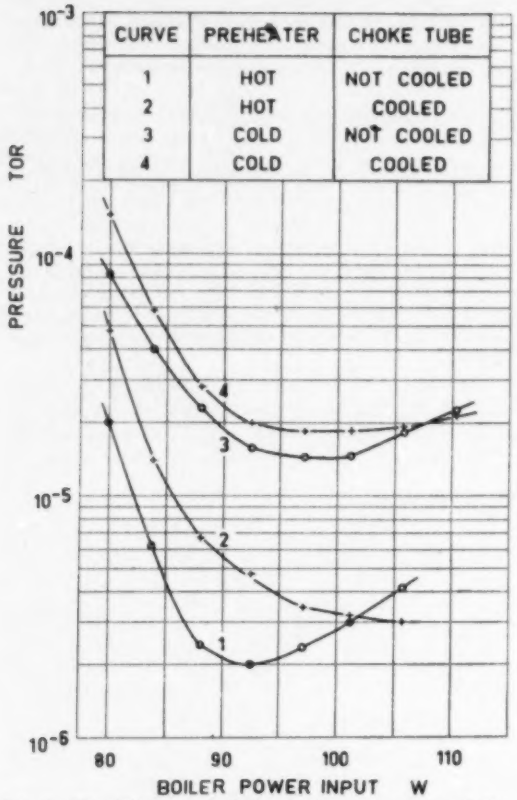

Fig. 2. The influence of oil impurities and cooling of the choke tube upon the pressure.

be obtained if both the oil reaching the forepressure side and the choke tube of the ejector jet were maintained hot.

Design and Performance of the Pump

These considerations were embodied in the design of a three stage oil vapour pump. The choke tube of the ejector jet being enclosed in vacuum is maintained hot during operation of the pump. Oil fractionation is carried out conventionally by the use of separate boilers. The high vacuum nozzle is of the type described previously by the author (Florescu, 1957).

The dimensions of the pump are indicated in Fig. 3. The line joining the bottoms of the three boilers is at an angle of $1\frac{1}{2}°$ to the horizontal in order to speed the return of oil to the high vacuum boiler. When the pump is not in use the boiler of the ejector stage contains only the half of the oil required for normal operation. Thus this stage heats faster, and therefore is the first to function. In less than half an hour the oil levels in all boilers become equal.

Using Apiezon C oil and air as a test gas, an equilibrium pressure of 7×10^{-8} Tor was measured in a vacuum system consisting of a thermionic ionization

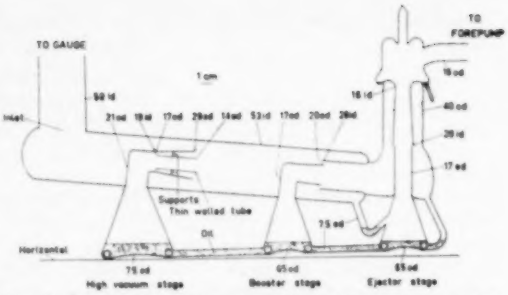

Fig. 3. Design of a three stage glass oil-vapour pump. The outside (OD) and inside (ID) diameters are given in millimetres. Linear dimensions can be read off from the accompanying scale.

gauge. The outgassing was carried out by torching the bulb and heating the electrodes electrically. No cold trap was used, but a rubber tube through which circulated tap water was wrapped around the inlet tube.

The speed was measured by a method described elsewhere (Florescu, 1958). The operating characteristics and performance of the pump are as follows:

Total quantity of oil: 65 cc.
Power input: 257 W (3·6 A).
Ejector stage: 75 W. (5 ohms).
Booster stage: 77 W. (5·2 ohms).
High vacuum stage: 105 W. (8·2 ohms).
Critical forepressure: 0·18 Tor.
Speed at the inlet: 30 l/s, measured between 10^{-4} and 10^{-5} Tor, at 22° C.

REFERENCES

Bächler, W. and Nöller, N. G. (1957). Z. angew. Phys., **9**, 612.
Florescu, N. A. (1957). Austral. J. Appl. Sci., **8**, 305.
Florescu, N. A. (1958). Appl. Sci. Res., **B7**, 63.
Hickman, K. C. D. (1936). J. Frank. Inst., **221**, 215.
Latham, D., Power, B. D., and Dennis, N. T. M. (1951). Vacuum, **1**, 97.
Lockenvitz, A. E. (1937). Rev. Sci. Instrum., **8**, 322.

Observations on the Examination of Casein Preparations by Paper Electrophoresis

(*Concluded from page 28*)

more, the authors are indebted to Mr. K. Brunfeldt, M.Sc., Nordisk Insulinlaboratorium, Copenhagen, for invaluable help in the choice of the experimental procedures. Finally we want to extend our thanks to Prof. G. Haugaard, visiting lecturer at this Institute under the Fulbright Programme, for valuable discussion during the writing of the paper.

REFERENCES

[1]Bloch, R. J., Durrum, E. L., and Zweig, G. (1958). 'A manual of paper chromatography and paper electrophoresis', p. 574.
[2]Hammarsten, O. (1877). Acta Reg. Soc. Scient. Upsaliensis, Nr. X.
[3]Hammarsten, O. (1883). Z. physiol. Chem., **7**, 227.
[4]Linderstrom-Lang, K. (1929). 'On the fractionation of casein.' Comptes-Rendus du Laboratoire Carlsberg, **17**, No. 9, 41.
[5]Macrae, H. F. and Baker, B. E. (1958). 'Application of electrophoresis on paper to the estimation of alpha, beta and gamma casein. J. Dairy Sci., **41**, 233.
[6]McMeekin, T. L. (1954). 'Protein chemistry: biological activity and methods,' edited by H. Neurath and K. Bailey. Vol. II, Part A, 389.
[7]Neurath, H., Greenstein, J. P., Putnam, F. W., and Erickson, J. O. (1944). 'The chemistry of protein denaturation.' Chemical Rev., **34**, 157.
[8]Putnam, F. W. (1954). 'Protein chemistry: biological activity and methods,' edited by H. Neurath and K. Bailey, Vol. I, Part B, 807.
[9]Tiselius, A. and Flodin, P. (1953). 'Zone electrophoresis.' 'Advances in protein chemistry.' Vol. VIII, 461.

THEORY AND PRACTICE IN THE PHYSICAL CHEMISTRY LABORATORY

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PART II.—INVESTIGATION VERSUS EXPERIMENT

IT HAS been pointed out in the first paper of this series, that the practical period should not be used merely for 'training' the student in the use of instruments, techniques and procedures, but should be used primarily for *educating* him to use his critical faculties to correlate chemical theory and practice. The major aim of chemical education is then to imbue the student with the proper *scientific attitude of mind* and not merely the amassing of theoretical information or gaining of practical experience. This aim can be furthered, as will be seen presently, by using the practical period from the standpoint of an *investigation* rather than that of an *experiment*.

One of the dangers encountered in the teaching of chemistry in specialized courses, such as degree courses, is the established classification into the main branches of physical, inorganic, organic and biochemistry. This sectionalization is continuously being extended as the main branches are divided into their sub-sections, e.g. in physical chemistry there are thermodynamicians, kinetics experts, surface chemists and so on. Increased specialization is unavoidable because it follows the continuously expanding horizons of chemical knowledge. This makes it difficult for a chemist to be a master of even a single main branch of chemistry. The result is that teachers of chemistry tend to view the overall chemical field in terms emphasizing their own subject and this attitude tends to be passed on to the student who is therefore encouraged—even if unintentionally—to regard the various branches of chemistry as segregated compartments. This attitude cannot be avoided altogether. However, one is faced with the problem: 'How can the student be taught to think in broad chemical terms rather than in terms of segregated compartments of physical, organic or inorganic chemistry?'

A great deal can be done in the lectures by emphasizing the correlation between the various branches. Even more can be done by the proper use of the practical period for the purpose of an *investigation* rather than merely that of an *experiment*.

The distinction between investigation and experiment is not easy to define. However, it may be summed up by saying that the former is concerned with several aspects of the problem, while the latter may be concerned with a single aspect only. When an experiment is to be made the student reads the section in the practical text-book which deals with the particular experiment. After the experiment has been carried out, the student records in his practical book the title of the experiment, its object, the procedure and a concluding paragraph. However, when an investigation is to be carried out, the scope is far wider. Considerable reading and thinking must be undertaken along with planning, and the overall summing up must take into consideration several aspects which are concerned with other factors besides the bare experimental account. It should include, for example, critical assessment of different tools or methods which can be used in the investigation.

Some might be inclined to consider an 'experiment' as a project more suitable for a laboratory period used during the teaching of *elementary* chemistry—such as is involved in the teaching of the Ordinary Level of the General Certificate of Education—whereas the ground covered by 'investigation' is more suitable for the more advanced levels of teaching, such as a B.Sc. degree course. However, one can marshal weighty considerations against this attitude.

All true education starts early in childhood; certainly scientific education starts at the very first stage when a pupil is taught General Science. More often than not the early scientific education proceeds along the correct lines, because the pupil is encouraged at that stage to develop an enquiring outlook. However, as soon as the preparation for examination stage is entered upon it is considered that 'swotting', 'cramming' and parrot-fashion learning are permissible and necessary techniques for passing examinations. Such beliefs are inculcated in the student by the attitude of those teachers who—while agreeing that such methods are educationally undesirable—mistakenly believe them to be justifiable. This attitude is fundamentally wrong for several reasons. The 'swot' and 'cram' methods encourage the student to accumulate scientific knowledge without the requisite understanding. The large number of facts, figures and unintelligible 'explanations' with which the memory of the student is overloaded results in increasing tendency to forgetfulness. Sometime before the examination, the student realizes that he has forgotten much of that 'knowledge' and he tries to rememorize it without understanding. The process is repeated leading to a tremendous waste of time, as it has been clearly established that memory of individual units belonging to an intelligent pattern lasts far longer than that of a number of apparently unrelated facts. The student seeking a short cut to memory does

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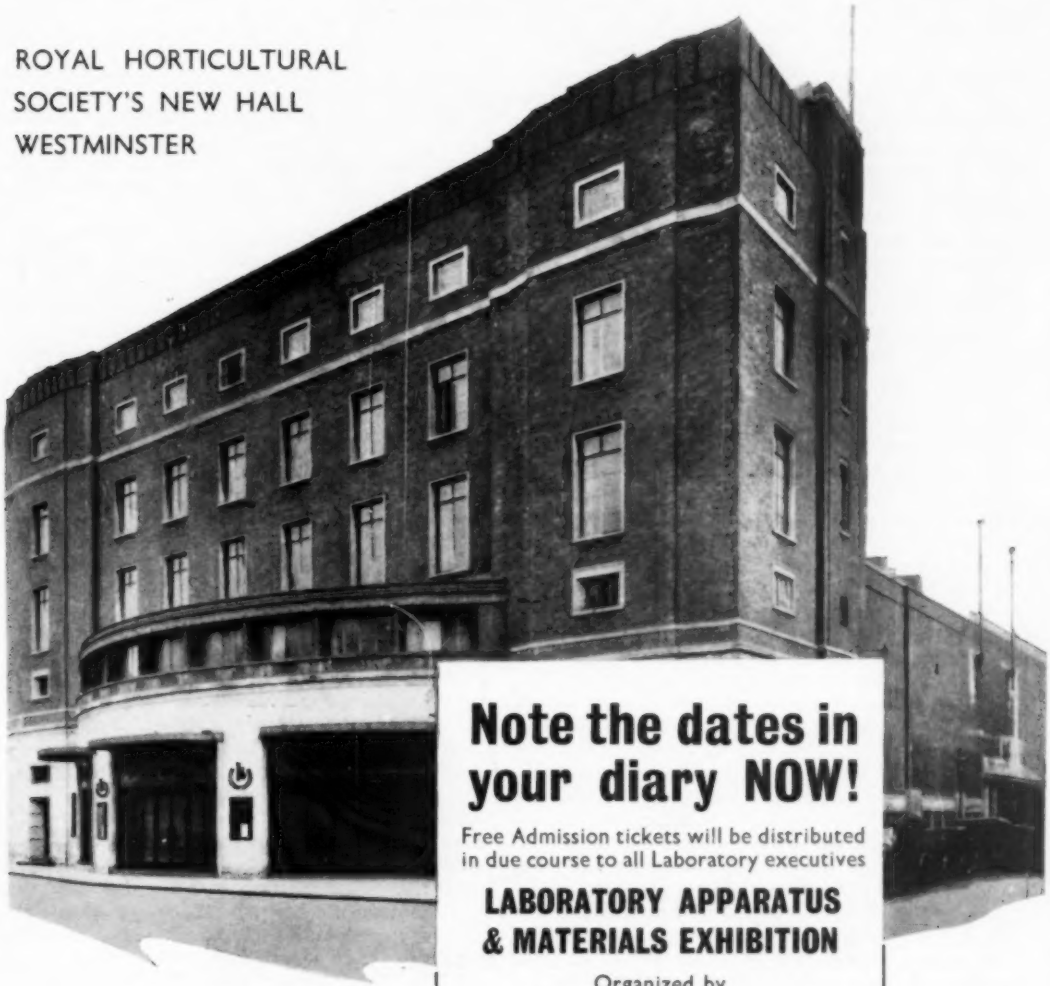

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not appreciate this and his continuous efforts to learn science by heart merely results in perpetuation of the wrong attitude towards scientific learning. Now, memory and intellect do not necessarily run side by side. The student with the greater retentive powers tends—because of the present type of examination paper—to obtain a higher examination mark. However, this is by no means a criterion of his capacity to deal with scientific problems or to correlate them. Unfortunately, quite a proportion of the student body, which has passed the Advanced Level examination, enters the B.Sc. courses with eyes partially, if not wholly, closed to the meaning of scientific patterns and their correlation. They enter the laboratory with the intention of carrying out set 'experiments'. If their laboratory supervisor is an 'experiment' devotee, they will continue on the old road and because of their attitude of mind will tend to get a lower class of Degree than that which they could have attained had they learnt to *think* scientifically and consequently attempted the intelligent application of scientific principles. (It should be remembered that the *Degree* examinations tend to put a higher premium on intelligent application of scientific principles than on their blind repetition). If, however, the supervisor is determined to fulfil his function, viz. that of *educating* the student in scientific principles and their application in the scientific laboratory, then there is hope for the originally misguided student. There is no doubt that some students—having been accustomed to 'swot' methods—resent being educated. Many students think of the attainment of a high qualification merely in terms of monetary rewards to be attained as quickly as possible and, above all, with the *least effort*; and as any mental effort is abhorrent to them they will tend to keep to their old habits. It is here that the determination of the teacher to follow his duty, whether it be popular or not, may well prove the deciding factor. This determination obviously depends on the teacher himself. He must have an enquiring mind and must be capable of imbuing the student with this attitude of mind. It is generally true that any teacher who has an enquiring mind tends to do research; and the more enquiring his mind the greater is the probability that he will carry out a scientific investigation and that he will succeed in imbuing his students with the correct scientific attitude of mind. The harvest gathered in scientific education depends not only on the tools available, but greatly on the men teaching the student the use of the tools.

Accepting the thesis that the student should be taught in the laboratory from the standpoint of *investigation* rather than that of *experiment*, the problem naturally arises how this is to be carried out and what modifications one should adopt in the normal way in which the practical period is used. As the overall problem is not confined to physical chemistry but applies to chemistry in general—and indeed any teaching of the practical aspects of a science subject—it is desirable to choose examples which will involve other laboratories as well.

Preparative Chemistry

The interaction between copper and concentrated sulphuric acid is used as an experiment for the preparation of copper sulphate and sulphur dioxide. The student normally carries out the work according to the directions given in the book and having isolated the required products records in his laboratory book the various related points such as procedures and care required. Some, if not much, of his account is a précis of what he found in the practical text-book. The reaction given in the book, viz.

$$Cu + 2H_2SO_4 = CuSO_4 + 2H_2O + SO_2$$

is quoted dutifully as representing the overall reaction. But does it? What about the small quantities of cupric and cuprous sulphide sludge found after the reaction? Are they to be conveniently forgotten, as some text-books prefer? Has the student really utilized the practical period fully so as to appreciate the various aspects of the reaction?

Let us formulate the preparation of copper sulphate and sulphur dioxide as part of the overall pattern of the *investigation* of the reaction between copper and sulphuric acid. The student should consider in his account not only the bare and dry details concerning the 'experiment', but should be concerned with the variables encountered in such a reaction, or its lack, viz. *concentration*, *temperature* and change of *reaction medium*. Let him consider concentration. Copper does not react with dilute sulphuric acid. The explanation given is that as copper is below hydrogen in the electrochemical series, its standard e.m.f. is lower than zero and therefore it cannot undergo the reaction of

$$Cu + 2H^+ = Cu^{++} + 2H \quad \ldots\ldots (1)$$

The situation alters however with rise in sulphuric acid concentration and with rise in temperature. The reaction does take place then. Consequently, we may conclude that the above reaction does proceed when copper is treated with hot concentrated sulphuric acid, though this seems to have escaped the text books. One should, of course, emphasize that the change of medium from an essentially aqueous one, where the reaction does not take place, to one essentially H_2SO_4 in character must play a significant role (cf. the reaction between Mg and very dilute HNO_3 when very pure hydrogen may be obtained; as the nitric acid concentration is increased, the nascent hydrogen formed reduces the nitric acid to ammonia). It is in the subsequent stages that the nascent hydrogen, initially produced, reduces some of the sulphuric acid to sulphurous. The latter, in presence of the sulphuric acid, loses its water and gives off SO_2. The nascent hydrogen is however capable of reducing some of the product right down to H_2S (or alternatively reducing the $SO_4^{=}$ to $S^{=}$) and the cupric state to the cuprous, thus being responsible for the formation of some cupric and cuprous sulphide sludge. (The student should investigate the sludge and assess the proportion of cupric sulphide to cuprous sulphide.)

The student should tackle the reaction from the

standpoint of the Law of Mass Action, which neglecting activity coefficients may be written thus

$$\text{Reaction rate} = k\,[\text{Cu}]\,[\text{H}_2\text{SO}_4] \qquad (2)$$

where k represents the velocity constant for the reaction represented in equation (1). He could then consider the increased rate of reaction with increased sulphuric acid concentration and increase in the value of k with rise in temperature. A more mature student would be expected to explain the increase of the velocity constant in terms of the equation

$$k = PZe^{-E/RT} \qquad (3)$$

where P and Z represent the probability factor and the number of collisions respectively, E is the energy of activation, and R and T represent the Ideal Gas Constant and the Absolute Temperature respectively.

The student's record of the reaction should therefore be an overall assessment and description of the various factors involved and not a mere précis of the contents of the corresponding section in the practical text-book.

Rate of Reaction Measurements

Consider the hydrolysis of methyl acetate which is often used as an experiment for the demonstration of a first order reaction. The hydrolysis may be carried out in acid solutions; often two experiments are carried out with different acid concentrations to demonstrate hydrogen ion catalysis—or in alkaline solutions resulting in the formation of sodium or potassium acetate. One or other of the reactions is used, but rarely both.

Whichever reaction is used, the diligent student studies the practical book section dealing with the experiment before he starts on the practical work. He then prepares the various solutions, cleans thoroughly the various glass vessels he requires and starts the reaction as early as possible on the appointed day so as to enable him to take measurements for a sufficiently long period. Having carried out the determinations he catalogues the data and calculates the velocity constant by the use of given equations, or evaluates it from a graphical representation. He may even go as far as assessing the significance of the values calculated by comparing them with available data and with data obtained from conductivity measurements.

What can we do to turn this experiment into an overall investigation which will encourage the student to recognize several other aspects of hydrolysis besides the ones mentioned above?

In the first place the investigation should be carried out by a *team* of two or three students who will at the end have to write *individual* reports about the project. The overall plan given should include consideration of hydrolysis of salts having weak acid anions and weak base cations and their combinations. The students' reports should differentiate between the rapid hydrolysis of many metal salts (some metal salts hydrolyse but slowly, e.g. stannic chloride) and the comparatively slow rate of esters. Both acid and alkaline hydrolysis should be considered. On the experimental side it should be possible, when a *team* of two or three are correlating measurements, (*a*) to compare the results in acid and alkaline solutions, (*b*) to compare the calculated values from direct manipulation of the equation and from graphical representation, thus enabling consideration and assessment of the two methods, (*c*) to obtain data at two different temperatures, thus enabling evaluation of the energy of activation and discussion of its significance in relation to the mechanism of the hydrolysis.

Many more examples can be given, but it is hoped that those above are sufficient to encourage the investigational attitude advocated here.

(To be continued.)

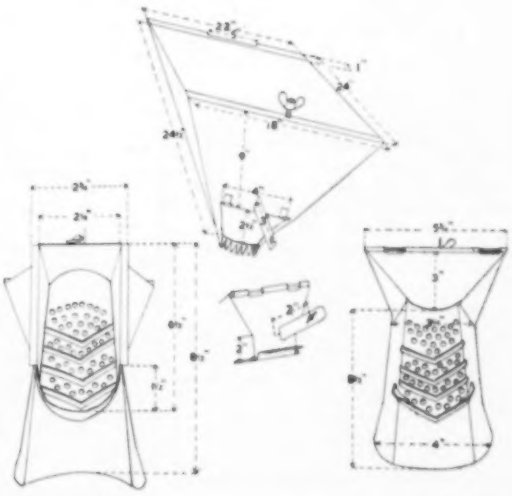
A SHEEP METABOLIC CAGE FOR MINERAL BALANCE AND RADIO-ISOTOPE EXPERIMENTS

by Iain F. Duthie, B.Sc., B.V.M.S., M.R.C.V.S.

Rowett Research Institute, Bucksburn, Aberdeen

With reference to the article published under this title in the December 1959 issue of Laboratory Practice (pp. 408-414), Fig. 6 (ii) on page 411 showed the incorrect dimensions.

The accompanying illustration is a reproduction of this drawing of the shute and separator giving the salient features with the correct dimensions, all measurements being in inches.



APPARATUS FOR ROUTINE ANALYSIS

by G. Lindley

Works Chemical Laboratory, English Electric Co. Ltd., Bradford

PART II—FRACTIONATING PIPETTE

Introduction

A very tedious operation in analytical work is the fractionation of large numbers of solutions whereby accurate aliquots are taken from standard volumes of solutions. This operation is also used when taking accurate volumes of liquid samples for analysis. A large amount of time is wasted in washing out the pipettes with each solution prior to its actual measurement. The simple fractionating pipette described below greatly reduces the time, and has many other advantages.

Description

A double oblique-bore stopcock is sealed to the upper end of a pipette of the required volume as shown in Fig. 1A. By careful manipulation the volume from the tip to the stopcock can be made very near to the required volume. Adjustment to accurate volume can be made by indentation or local blowing on the bulb during glassblowing, calibration being carried out by weighing distilled water deliveries. For pipettes of smaller volume, e.g. 0·5 ml. and 1 ml. capillary type tubing can be used as shown in Fig. 1B.

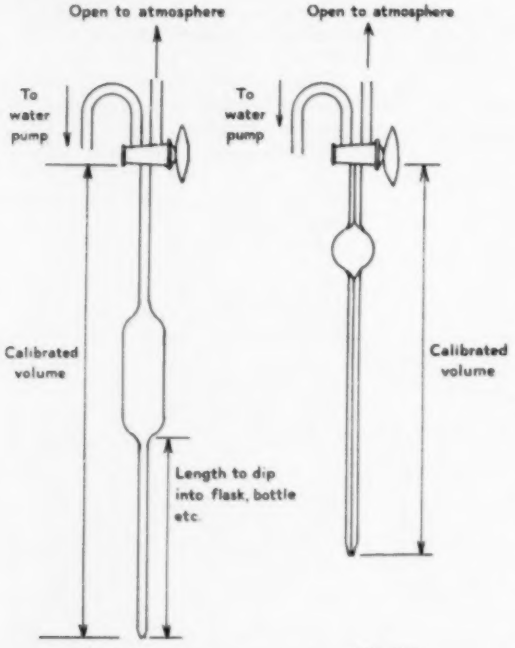


Fig. 1A. Fig. 1B.

Fractionating pipettes.

For operation, one arm from the stopcock is connected by pressure tubing, to a water vacuum pump. The graduated flask or sample bottle is brought to the pipette which is conveniently mounted on a stand. The solution vessel is raised so as to immerse the pipette tip well into the liquid. The stopcock is turned to connect to vacuum and within a few seconds the pipette has been washed out with the test solution. At this stage the stopcock is turned to 'neutral' when the graduated flask can be withdrawn and the aliquot remains in the pipette. The beaker or other receiver is now brought under the pipette, the stopcock turned to connect to atmosphere, and the solution now delivers into the receiver. The pipette is now ready for the next solution.

Calibration results for a typical 10 ml. pipette made in the laboratory showed a mean delivery of 10·032 ml. (i.e. 0·32 per cent relative error). The maximum deviations from this mean were −0·008 ml. and +0·009 ml. (i.e. −0.079 per cent and +0.089 per cent from mean). These results are well within normal requirements. Pipettes of this type are now available from Ralph Cuthbert Limited, Westgate, Huddersfield.

Applications

Several of these pipettes of different capacities are now in use in the routine section of the laboratory, and show a great saving in time. Breakages have been greatly reduced and pipetting has been simplified for routine operations. When sampling toxic solutions such as electroplating solutions containing cyanide, the pipettes are perfectly safe in operation and are much more convenient than the normally available 'safety pipettes'.

A multiple set-up of pipettes is in use, all connected to a common water pump line, as the stopcocks act selectively for each pipette. When working with cyanide solutions, a separate assembly is reserved for this work, using a separate water pump and sink to avoid mixing of the cyanide waste with acidic solutions, etc.

ACKNOWLEDGMENT.—*The author is indebted to the English Electric Co. Limited, for permission to publish this paper.*

THE PHYSICAL SOCIETY

44th Exhibition of Scientific Instruments and Apparatus

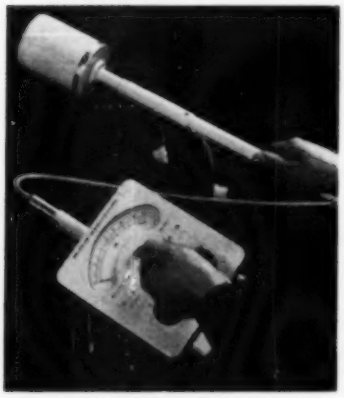
This year's Physical Society Exhibition will be held at the Royal Horticultural Society's Old and New Halls, Westminster, London, S.W.1 from January 18 to January 22. The opening ceremony will be performed in the New Hall, on January 18, at 11 a.m. by Mr. J. A. Ratcliffe, C.B.E., M.A., F.R.S., President of the Physical Society. This preview of some of the exhibits will provide intending visitors with a guide to what may be seen on the stands of participating firms and Research Establishments.

Admiralty Research Establishments (Stand 40)

(*a*) *Admiralty Surface Weapons Establishment.*—Included in these exhibits will be a low noise S-band parametric amplifier to be shown working; high speed symbol writing equipment, the demonstration model illustrating the display of symbols on a cathode ray tube at a speed of over 100,000 characters per second; high power waveguide terminations; microwave scanner unit; digital data recording system designed to give fully automatic recording of experimental and trials data in digital form; and a short pulse generator. The principles of a method of further shortening and amplifying pulses with a parametric line will also be demonstrated.

(*b*) *Admiralty Research Laboratory.*—Here will be demonstrated the measurement of zeta potential in which the streaming potential produced by the passage of an electrolyte solution through a plug of a granular material (alumina) is measured directly with a Vibron electrometer; an automatic film analyser; and the measurement of mutual radiation impedance of rigid piston sound sources in an array.

(*c*) *Admiralty Materials Laboratory.*—Exhibits will be devoted to curved crystal x-ray spectrometers and the use of silicon nitride as a high temperature engineering material.



Avo hot spot monitor.

VISIT THE U.T.P. STAND

Enquiries concerning their publications will be welcomed by United Trade Press, Ltd., at Stand No. 60. Among the journals and publications to be displayed will be: *Laboratory Practice, Instrument Practice, Automation and Automatic Equipment News, Radio and Electronic Components,* **'Course in Industrial Instrument Technology,' 'Electrical Measuring Instrument Practice,' 'Laboratory Control of Dairy Plant,' 'The Industrial Application of pH Measurement and Control,' and 'The Industrial Manual.'**

(*d*) *Services Electronics Research Laboratory.*—Floating zone equipment which can be used for the production of single crystals and refining of gallium arsenide will be shown, together with arsenide material and devices employing it.

Avo Ltd. (Stand 90)

The valve characteristic meter, Mark IV, will be featured. In addition to covering all the facilities existing on the earlier instruments, the following additions have been made:

(a) A considerably increased facility for the correct setting of negative grid potentials, particularly at low values.

(b) More accurate and concise methods for determining grid current, particularly when testing a valve which suffers from reverse anode current or primary emission.

(c) The inclusion of additional anode voltages for the testing of the recently introduced low anode voltage valves.

(d) An improvement has been made in the regulations of the anode and screen voltage source to reduce reflected impedance problems.

Other exhibits on this stand will include a transistor analyser, hot spot monitor, magnetic memory scaler with indicator unit, high frequency response magnetic memory scaler, electronic test meter Mark V, signal generator, pulse modulation adapter, A.M./F.M. signal generator.

Associated Electrical Industries Ltd. (Stand 123)

(*a*) *A.E.I. Electronic Apparatus Division.*—The BK. 178 and BK. 194 ignitron switches for thermonuclear research will be shown. These ignitrons withstand voltages of up to 25 kV. (forward and inverse) and pass currents of peak value 40,000 amp. and 80,000 amp. respectively.

(*b*) *A.E.I. Lamp and Lighting Co., Ltd.*—Among the exhibits to be seen will be the movement of ions in sodium vapour—rare gas discharge will be demonstrated using a stroboscopic projection technique; Xenon and electronic flash tubes, and laboratory type special projection lamps including (i) lamps with fused silica envelopes for infra-red and ultra-violet radiation and (ii) projector lamps incorporating internal mirrors.

(*c*) *A.E.I. Research Laboratory, Aldermaston.*—Featured will be a thermoelectric recording hygrometer, electron beam focusing by magnetic quadrupoles and measurement of very low attenuation in waveguides in which the small frequency differences are measured by a waveguide delay-line frequency discriminator, the output of which is capable of accurate absolute calibration.

(*d*) *A.E.I.—Birlec Ltd., Birmingham.*—New laboratory equipment for the drying of gases to moisture content of 1

During the Exhibition, discourses (Demonstration - Lectures) will be given at 5.45 p.m. as follows: *January 18,* **'Some Reactions of the Human Body to the Stresses of High Performance Flight,' by Flt. Lt. J. Billingham (R.A.F. Institute of Aviation Medicine).**
January 19, **'Atomic Time,' by Dr. L. Essen (National Physical Laboratory).**
January 20, **'Recent Advances in Solid State Physics,' by Dr. D. A. Wright (Research Laboratories of the General Electric Co., Ltd.).**

Measurement of very low attenuation in waveguides by A.E.I. Research Laboratory, Aldermaston Court.

p.p.m. by the use of molecular sieves will be exhibited together with a simple dew point apparatus for use down to —50° C. The design and construction of a new type of nitrogen purification plant for the provision of super purity nitrogen will be demonstrated by means of animated flow diagrams.

(*e*) *A.E.I. (Rugby) Ltd.*—This company (formerly BTH) will be showing microwave heating equipment, the latest types of silicon controlled rectifiers, silicon transistors, an electronic profile analyser and ceramic metal seals.

(*f*) *A.E.I. (Manchester) Ltd. Research Laboratory.*—A demonstration of an analogue multiplier utilizing a Hall effect unit and associated transistor circuits will be given. Also on show will be a selection of different probes used in a high resolution nuclear magnetic resonance spectrometer and an experimental digital differential analyser. Of particular interest to laboratory workers will be the 2 in. laboratory mass spectrometer—a small compact instrument of the 180° C. deflection type, employing a permanent magnet and with a resolving power of 50 and a mass range of 2-100.

(*g*) *A.E.I. (Woolwich) Ltd. Research Laboratory.*—Digital circuits operating at 1 Mc/s., an experimental light amplifier pick-up tube and arc discharge lamps will be shown.

(*h*) *A.E.I. Instrumentation Division.*—A wide range of equipment will be shown in this section, including a production model x-ray analyser, a Raymax 60 x-ray fluorescence spectrometer, a full range of vacuum equipment, a pulse height analyser with print-out and recorder output, and a prototype of a new unitized system designed for reactor flux measurement and control, radiation monitoring and fission product detection.

Baird & Tatlock (London) Ltd. (Stand 127)

New instruments developed by both the Analmatic and General Instruments sections of the Research and Development Division will be shown. The following additions to the range of B.T.L. Analmatic equipment for automation in analysis will be on view:

Auto-Titrator (Motorized Pipette Type)—an inexpensive fully automatic titrator for process monitoring. The instrument demonstrated is adapted to perform automatically the standard Winkler method for the determination of dissolved oxygen in water.

Wide Bore Polarograph—for dissolved oxygen in water, suitable for field use, for operation by batteries or A.C. mains.

Polarographic Pre-Treatment Unit—designed for use in conjunction with an external polarograph for automatic process monitoring.

Proportioning Pipette Units (Peristaltic Pump Type)—for rapid repetitive dispensing of equal aliquots of liquid from one vessel into another.

HCl Gas Analyser—for the automatic measurement of HCl concentration in air.

Automatic Pipette—for use in routine analysis where large numbers of measured 'doses' of the same reagent or diluent are required daily.

Exhibits from the ranges of standard laboratory instruments and apparatus will be:

Zone Melting Apparatus (N.C.L. Pattern), Semi-Micro Model—for refining small amounts (0·15 g. to 2 g. approx.) of organic compounds to a very high degree of purity or for the concentration of small amounts of impurities in samples for analysis.

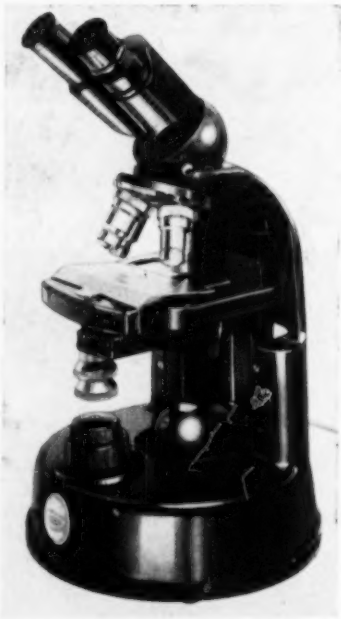
Centrifugal Chromatograph—for the high speed development of paper chromatograms using either paper discs or strips.

Gas/Solid/Chromatography Apparatus (Janak)—a portable version of the classical Janak apparatus designed for the analysis of gases at room temperature.

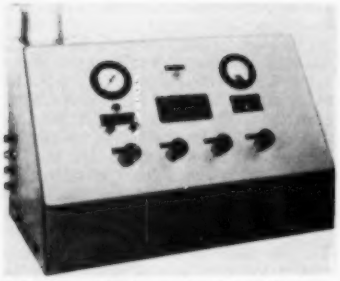
Multiple Geiger Counter Chromatogram Scanner—for the rapid evaluation of radioactive chromatograms.

C. Baker Instruments Ltd. (Stand 79)

Sterimags, the Patholette and an interference microscope will be shown on this stand. Sterimags are low power stereoscope microscopes for laboratory and industrial uses. The Patholette series of instrument is believed to represent the greatest advance in the mechanical design on the microscope for many years. The usual rack and pinion have been dispensed with in favour of a lever and scroll type focusing which in the prototype has sustained more than a million focusing movements without wear. The usual expensive mahogany case is dispensed with in favour of a high impact Polystyrene case which fits round the base of the microscope. The Patholette is designed to cover the range from student and sixth form microscope to the binocular routine laboratory microscope. The Baker birefringent interference microscope will be shown in its double-focus and shearing forms. It is an instrument



The Patholette.
C. Baker Instruments Ltd.

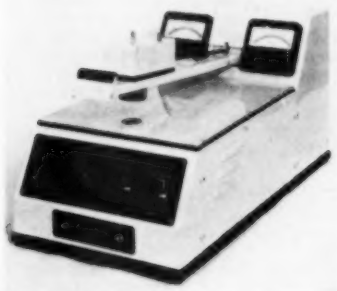


Palladium diffusion unit. *Baker Platinum Division of Engelhard Industries.*

for the examination of unstained preparations in interference colour contrast and it can also be used for the measurement of refractive indices, protein concentration of dry weight of such preparations as living cells and other biological materials.

Baker Platinum Division of Engelhard Industries (Stand 45)
Exhibited on this stand will be various refractories coated with platinum, together with sectioned specimens illustrating the bond achieved; high temperature thermocouples for the measurement of temperatures above the range of established platinum and platinum-rhodium combinations; a palladium diffusion unit which will purify a maximum of 5 cu. ft. per hour of commerical cylinder hydrogen; platinum filter discs for fluid filtration under conditions of high temperature or in corrosive environments; and aperture discs of platinum and molybdenum for use as lens and condenser apertures in electron microscopes. Each disc is accurately drilled with a hole concentric with the outer diameter of the disc, and designed to fit the standard fitments of all makes of electron microscopes.

Baldwin Industrial Controls (Stand 112)
This company will be showing a wide range of equipment among which may be mentioned the fast responding Atomat nucleonic thickness gauge, the automatic standardizing Atomat with air purged head, a transportable beta radiation thickness gauge, transverse profile Atomat, several types of densitometer, a flame photometer, a Colormat and a radiological densitometer. This latter equipment has been designed primarily for measuring the low densities of film badges worn by personnel subjecting themselves to radiation. An illuminated table also allows the instrument to be used for viewing as well as measuring the density of x-ray plates and films.



Radiological densitometer. *Baldwin Industrial Controls.*

Barr & Stroud Ltd. (Stand 51)
Included in the exhibits on this stand will be a wide range of optical filters, a high speed streak camera into which different combinations of rotating mirror unit and optical systems can be fitted, a chart comparison unit intended mainly for use on board ship but also with applications in survey work, and a model of an atomic reactor periscope which shows some of the main features of a monocular periscope intended for use in observing the inside of the pressure vessel of the Berkeley gas reactor, normally under 'closed down' conditions of pressure and temperature, but also, in emergency, under full load conditions.

R. & J. Beck Ltd. (Stand 80)
Microscopes, spectroscopes, cathetometers and null-point absorptiometers will be featured on this stand. The microscopes include the Multimax stereoscopic type, the accessories for which now include gliding and tilting stages, the Optomax research microscope for which a unit has now been developed enabling binocular observation and photographic recording to be conducted simultaneously, and a student metallurgical microscope with integral illumination. The Hartridge reversion spectroscope has recently been redesigned optically to increase the accuracy of setting of the absorption bands in the spectrum. The research cathetometer incorporates the features normally associated with this type of instrument, including a 1 metre vertical scale with micrometer adjustment to read by vernier or drum to 0·01 mm. A novel feature of this instrument is the special telescope which, in addition to providing the main viewing system, incorporates a flick-in prism system so that an image of the main levelling bubble is presented in the eyepiece enabling the pillar and carriage to be checked and set for position without removing the eye from the eyepiece of the telescope. The null-point absorptiometer is a prototype of a new instrument developed in collaboration with Dr. R. H. Kay of the University Laboratory of Physiology at Oxford. This new instrument avoids some of the more common deficiencies of filter photometers and promises speedy and accurate determinations of, for example, blood oxygen saturation plus a sufficient versatility for use in general biochemical and chemical assay.

Research cathetometer. *R. & J. Beck Ltd.*

Bellingham & Stanley Ltd. (Stand 107)
A wide range of refractometers, polarimeters and interferometers will be displayed on this stand. Of particular interest will be the prototype R.320 refractometer which is designed for measuring the refractive index of liquids throughout the U.V. and visible ranges. In its present form it is a laboratory instrument and capable of measuring quite small quantities of liquid. The Fabry-Perot-Michelson interferometer is basically a simple Fabry-Perot interferometer but with the addition of the special attachment can be converted to a Michelson interferometer. It is eminently suitable for student use and has all the accuracy required for this purpose. Included in the display will be a full range of pocket refractometers. The models are calibrated for sugar determination, refractive index measurements, starch determinations and measurements of H.T.P.

Birmingham University, Physics Department (Stand 137)
Of special interest on this stand will be the intraocular foreign body locator. This is a device for locating small metallic or magnetic foreign bodies ledged in the eye with sufficient precision to permit removal by surgery. It consists of an inductance-resistance bridge in

which one inductance arm is mounted on the end of a small probe. The bridge is sensitive to an unbalance of about 1 part in 10^6 and a phase sensitive detector indicates the phase direction of the permeability of the foreign body, thus distinguishing between magnetic and non-magnetic objects. As the probe may be subjected to large changes in temperature, for example, if it is sterilized by immersion in a spirit solution and then placed in contact with the eye, the bridge has been made insensitive to changes in resistance due to temperature, while retaining high sensitivity to induced loss caused by non-magnetic objects. With the smallest probe an object of 1 $mm.^3$ can be located with an accuracy of about $\pm$ 1 mm. at a distance of 5 mm., while being insensitive to metal objects 10 cm. away. A later development is to be a ferrite-cored probe which will have a greatly increased sensitivity at the expense of reduced location accuracy.

E.R.A. test cell.

The British Cotton Industry Research Association (Stand 44)

The pyrometer on this stand (Shirley Developments Ltd.) offers a solution to the problem of measurement of surface temperatures of rollers, cylinders, etc., that are heated to temperatures in the approximate range 50°-150° C. and which are in rotation. Standard surface pyrometers cannot be used for this purpose (unless the speed of rotation is very low) because of frictional heating errors and because of wear of the temperature sensitive bimetallic strip in the pyrometer. These difficulties are overcome in the modified pyrometer by the use of thin strips of polytetrafluorethylene (PTFE, Fluon or Teflon) to front and back the bimetallic strip in the instrument. Thus the pyrometer may be applied to a moving surface without significant frictional effects or damage to the bimetallic strip. In the event of wear or damage to the front strip of film, it is easily, quickly and cheaply replaced. Suitable choice of film thickness for the protective strip enables a rapid and accurate measurement of temperature to be made.

British Electrical and Allied Industries Research Association (Stand 44)

The E.R.A. exhibits on the D.S.I.R. stand will include a new test method for the detection of organic impurities in insulation. A test for the conductivity of an aqueous extract of solid insulation is often included in materials specifications, and is of particular value where insulation is used in damp situations. Water soluble impurities can lead to corrosion and early failure. It is not generally realized, however, that even when insulation is completely dry, impurities, usually of an organic nature, may be present which dissociate and, under electric stress, lead to harmful electrode reactions and rapid deterioration of the insulation. In oil-immersed equipment such impurities may diffuse from miscellaneous materials included in non-stressed regions of the assembly through the oil to the dielectric proper and premature failure may ensue.

The Electrical Research Association has developed a test for detecting organic impurities in materials likely to affect insulation in this way or for checking the purity of the insulation itself. The suspected material is extracted in highly purified trichlorethylene and the change in the d.c. conductivity of the solvent is determined. For this purpose the E.R.A. has designed a test cell with a capacity of only 3 ml. of test liquid. The electrodes and other metal parts of the cell are rhodium plated, the insulation is P.T.F.E. and the cell is readily cleaned. The test has already been successful in eliminating materials which had been responsible for short lives in impregnated paper capacitors. The E.R.A. has made a number of these new cells in its workshop for sale to members who may wish to purchase.

The international test for resistance to tracking (I.E.C. test) will appear to an increasing extent in the work of British manufacturers and users of dielectric materials. The E.R.A. apparatus also displayed carries out this somewhat lengthy test automatically. The apparatus is that which is now commercially available from Southern Instruments Ltd.

B.F.M.I.R.A. FIRA/NIRD extruder.

The British Food Manufacturing Industries Research Association (Stand 44)

Another exhibit on the D.S.I.R. stand will be the FIRA/NIRD extruder, shown by B.F.M.I.R.A. This instrument was originally devised by Mr. J. H. Prentice (of the National Institute for Research in Dairying) during research on the consistency of butter, and was used for his investigations into the rheological properties of margarines (domestic, cake and pastry) and compound cooking fats, carried out on behalf of B.F.M.I.R.A. The instrument is used to force the material under examination through an orifice at a constant speed. During this operation the thrust required to extrude the material is continuously measured and recorded on a paper chart which then provides a permanent record of the behaviour of the material throughout the test.

The instrument has been found suitable for use with a wide variety of foodstuffs, in addition to the fats already mentioned, fondant, fondant icings, marzipan, jellies, and piping jellies. It should be emphasized, however, that the use of the extruder will not be restricted to the food industry alone, as it will be most valuable in measuring the texture of any material capable of being forced through an orifice.

The commercial form of the FIRA/NIRD extruder has been developed in conjunction with H. A. Gaydon & Co. Ltd., from whom the instrument can be obtained.

The British Iron and Steel Research Association (Stand 44)

This exhibit will show a Ramey magnetic amplifier used in the construction of logical elements. It can be cascaded into a delay-line, pulse repetition rate counter, or pattern generator, and is shown here in a pattern generator controlling a d.c. motor. The 150 c/s power supply for the logical units is obtained from a frequency tripler which has no moving parts.

British Physical Laboratories (Stand 20)

An electronic instrument which has been developed for accurate measurement of the R.P.M. of internal combustion engines and is intended as an accessory to the everyday motor car will be shown on this stand, together with an electrolytic condenser bridge (CB.154-G) which

measures at a bridge frequency of 1,000 cycles, a megohmmeter Model RM.160—a completely new instrument for the measurement of insulation resistance up to 400 million megohms, a component comparator, Model CZ.457 Mk. 11, and a conventional type of four dial Wheatstone bridge adapted to modern requirements. This instrument covers a range of 0·1 ohm up to 10 megohms, maintaining an accuracy of 0·1 per cent over the entire range. The required high degree of discrimination has been achieved by applying the d.c. out-of-balance voltage to a chopper amplifier followed by a visual null detector. An additional advantage of this arrangement consists in passing a very low d.c. current through the resistor under test, thus preventing self heating. The maximum loading at any value is 16 milliwatts. To facilitate the reading of the final result, an optical 'read out' is provided, i.e. the result is indicated by four luminous figures arranged in line, including a luminous decimal point. The multiplier setting is also indicated on an illuminated panel.

British Scientific Instrument Research Association (Stand 77)

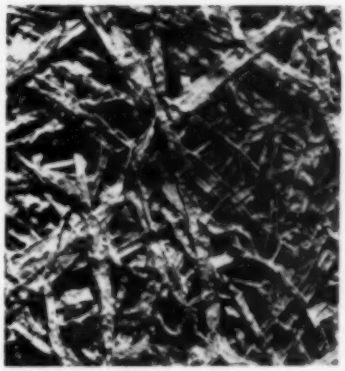
While every effort is made in the design of ordinary photocells to minimize the variations in response as the incident radiation is moved across the sensitive area, the photodiode to be demonstrated here is intentionally designed to produce the opposite effect. The device is used with a small spot of light focused on the receiving surface, and when this spot is moved between the electrodes the voltage output changes sign passing through zero in the central position. A test rig designed for evaluating the performance of these highly sensitive detectors for displacements of the order of a microinch will be demonstrated. The linearity of response, the responsivity in terms of volts/inch/lumen and the stability of null can be studied with this apparatus.

The device may be excited to give an a.c. output which changes in phase at null.

The ultrasonic flowmeter also to be shown has been developed by B.S.I.R.A. for the National Research Development Corporation. The flowmeter is intended for measurement of flow of 'difficult' fluids which are not amenable to measurement by existing types of meter. Such fluids may be highly corrosive, or contain suspended material which impairs the performance of meters which rely upon elements immersed in the fluid being measured. The flowmeter to be exhibited has been designed for a flow rate of 40 gallons of water per minute in a two-inch diameter pipe. Both flow rate and integrated flow readings are presented.

British Paper and Board Industry Research Association (Stand 44)

The technique of metal shadowing is used widely in electron microscopy both



Fibres in a typical sheet of paper. *British Paper Board Industry Research Association.*

to increase the contrast of a specimen and to give information on the extent of the specimen in depth. It is not generally realized, however, that this technique has an intrinsic value when used for the study of surfaces in the light microscope. At the Paper Research Association, methods have been developed, using metal shadowed replicas, for the light microscopy of paper surfaces. Paper, after metal shadowing, is pressed on to hot polystrene, and after a series of steps involving the dissolution of the paper and polystyrene, the metal shadowing is left embedded between two clear plastic layers of similar refractive index. The contrast in the image when viewed in transmitted light then arises entirely from the local variation in thickness, and hence transmissivity, of the shadowing and after photographic reversal gives a complete illusion of oblique illumination. At the same time the microscope, being operated in transmitted light on a thin contrasty specimen varying only in transmissivity, provides the maximum resolution of which it is capable.

Burndept Ltd. (Stand 29)

Included in the display to be staged by this company will be the digital valve voltmeter type BE.246, the press output monitor type BE.250, a Transikator type BE.245, a nucleonic thickness gauge type BN.119, industrial radiation switch type BN.131, a Universal scintillation counter type BN.120, U.H.F. power meter type BE.261, a radiation monitor ratemeter type BN.110, Mk. 11 and several displays of the proximity switch to the solving of industrial problems. Of particular interest will be the Universal scintillation counter which combines, in its various forms, features which enable its use in most applications. The basic unit consists of an 11 stage 2 in. diameter photomultiplier mounted in an anti-vibration seating and housed in a metal tube, the tube also contains the high resistance dynode chain. This unit, complete with crystal, forms a general purpose probe. A wide angle collimator and lead skirt may be screwed to the basic unit to provide a counter with directional characteristics. Adaptors which enable the basic unit to be modified for use in chromatography experiments and for liquid counting are also available.

Cambridge Instrument Co., Ltd. (Stand 97)

The four main exhibits to be seen on this stand will be a recorder incorporating a taut-suspension galvanometer movement, a precision four dial potentiometer, a precision voltage-measuring console and the Cambridge scanning electron-probe x-ray microanalyser.

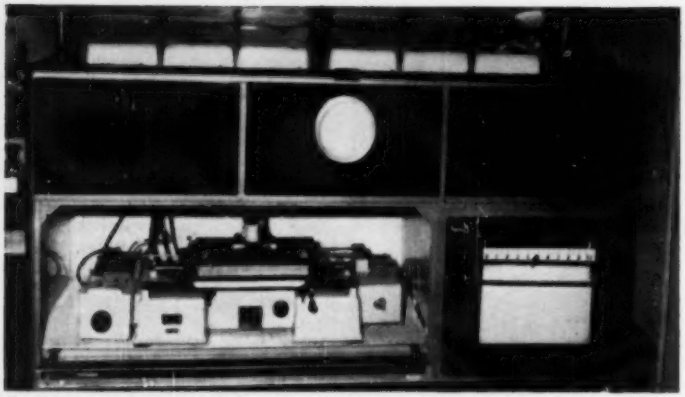
This latter instrument provides a powerful method of qualitative and quantitative metallurgical analysis by the technique of irradiating a minute area of the surface of a metallic sample with a fine-focus beam of electrons, and analysing the resulting emission of x-rays excited in the sample. The scanning x-ray micro-analyser has already proved itself an exceptionally useful research tool for examining inclusions, the segregation of the constituent elements of an alloy, the effects of electrodepositing one metal on another, etc. Although it has so far been used almost exclusively for studying metallurgical and mineralogical problems, it seems likely that, as soon as its potentialities are more fully explored, it will prove equally useful to the chemist and biologist who is concerned with problems where the precise examination of microstructure is important.

Cambridge University, Cavendish Laboratory (Stand 136)

An automatic single crystal diffractometer will be shown which has been designed to eliminate the laborious hand setting of conventional single crystal x-ray diffractometers and to make the collection of accurate intensity data by counter techniques comparable in speed and convenience with standard photographic methods.

Chance-Pilkington Optical Works (Stand 84)

Four new developments in high quality optical glass will be exhibited on this stand. These are a solid glass radiation shielding window, a colour temperature conversion filter for photographic use, zero stress optical coefficient glass and optical glass in strip form 9 in. wide. Designed for radioactive laboratory work, the solid glass radiation shielding window permits observations on radioactive materials. On receipt of radiation from a Cobalt 60 source, the protection offered is equivalent to that given by 48 in. thickness of normal concrete or 9·5 in. of lead. The overall dimensions of the 'hot' face of the window to be exhibited are 40 in. by 28 in., and the thickness is 29¼ in. The colour temperature conversion filter is of solid glass as opposed to the gelatine coated filters already manufac-



Dual presentation microphotometer. *Chemical Inspectorate, Ministry of Aviation.*

tured by the company. This straw coloured filter reduces the apparent source of colour temperature.

Chemical Inspectorate, Ministry of Aviation (Stand 1)

Included in the exhibits on this stand will be a recording analytical balance which is an up-to-date version of that devised by the French scientist, Guichard, who, over 30 years ago, made use of a simple hydrostatic system to compensate for losses in weight as they occurred on the pan of a normal non-aperiodic analytical balance. The apparatus to be exhibited operates on the same simple principle. Other exhibits will be a calculating board for use in spectrographic analysis, a Hilger non-recording microphotometer, normally used in conjunction with a galvanometer and scale for measuring the densities of spectrum lines, which has been modified to present results in two alternative ways, and a projector which has been developed in collaboration with the Metallurgy Division of the Royal Aircraft Establishment (Farnborough).

The Coal Tar Research Association (Stand 44)

The two exhibits to be shown by this Association (on the D.S.I.R. stand) are a rolling ball viscometer and an emissivity detector. The luminosity of a coal gas flame under certain conditions is linearly dependent on the concentration and chemical structure of organic vapours contained in it. This fact is utilized to follow the separation of substances in a gas chromatographic column by eluting them into the flame and measuring the variations in luminosity which occur. A simple optical system is used to concentrate the light on to the photo-voltaic cell and the resulting e.m.f. is measured continuously by means of a potentiometric recorder. The device is especially sensitive at high column temperatures and is useful for the characterization of different chemical types.

Cooke, Troughton & Simms Ltd. (Stand 88)

Microscopes, an aspirated hygrometer and a cadmium sulphide photocell device will be featured on this stand. The technician's microscope is an entirely new range of microscope. The focusing control heads are concentric and are located below stage level, the focusing mechanism being housed within the hollow pedestal. A friction clutch is brought into operation as a safeguard against damage due to overrun at the upper and lower limits of the focusing movement. The constant working distance stereoscopic microscope to be shown differs considerably from the conventional form of stereoscopic microscope. Instead of having twin objectives inclined inwards so that their optic axes meet in the plane of the specimen, it uses one objective and an optical system in the body of the microscope and passes left-and right-handed images to the eyepieces to produce the sensation of depth. Thus the

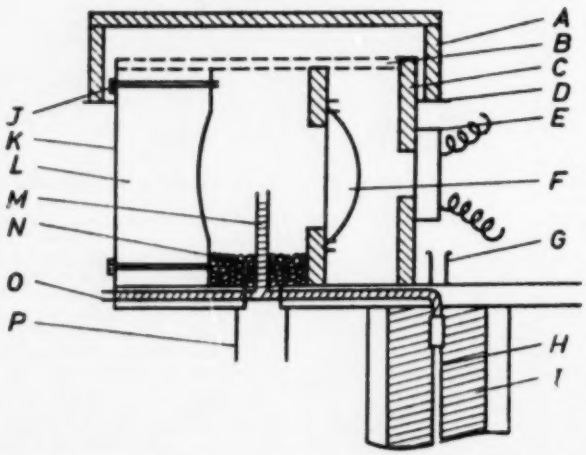


Diagram of emissivity detector. A, draught proof Sindanyo top. B, double layer of 40 mesh copper gauze. C, Sindanyo front for photo-cell mounting. D, metal stops for draught-top. E, selenium photo-cell. F, glass condensing lens. G, column inlet. H, column. I, column heating jacket. J, supports for reflector. K, aluminium housing. L, metal reflector. M, stainless steel jet. N, 2 cm. deep layer of porcelain beads. O, coal gas inlet. P, air inlet from blower. *Coal Tar Research Association.*

Stereoscopic microscope. *Cooke, Troughton & Simms, Ltd.*

Dawe Instruments Ltd., transistor vibration meter.

same effect is produced as with the more usual type of stereoscopic microscope but with the advantage that the whole of the field of view is in focus. The aspirated hygrometer, although new in design, is directly developed from the well-known Assmann hygrometer.

Cossor Instruments Ltd. (Stand 103)
A large selection of prototype and new production instruments will be shown on this stand. Among the prototypes may be mentioned the nanosecond light pulse generator, high-speed CRT unit, high speed single-beam oscilloscope, true R.M.S. voltmeter, transistorized oscillograph, external amplifier for Model 1035 Mk. III oscillograph, a double-beam oscilloscope and a signal delay unit. The production items include a signal generator, L.C.R. bridge, transistor tester and various types of transistorized power supplies.

Dawe Instruments Ltd. (Stand 118)
A wide range of instruments will be featured by this company covering such items as impedance comparators, transistor audio oscillators, transistor output power meters, soniclean generators, filter units, the Stroboback, vibration calibrators and variable bandwidth filters. Also to be shown will be the type 1431 transistor vibration meter—a compact and portable battery operated instrument designed to measure vibration displacement, velocity and acceleration, which is particularly suitable for field use.

Decca Radar Ltd. (Stand 18)
A new design principle employed in the I.F. sweep generator to be shown by this company provides very wide band operation. Used in conjunction with a standard cathode-ray oscilloscope, it can display the response characteristics of wide-band circuits. Other items to be shown will include oscillators, wave-meters, test sets, power supplies, amplifiers and waveguide switches. Some recent developments in the application of thin-film techniques will also be shown.

Dobbie McInnes (Electronics) Ltd. (Stand 14)
Demonstrations of an analogue/digital converter and of a table top plotting device will be given on this stand. Other instruments to be displayed will be a continuous reading viscometer designed for continuous measurement of oil in pipe lines and containers and a continuous line graph plotter. This particular unit takes the information in the form of punched tape or keyboard input and plots the results in the form of a series of straight lines. Printed information can also be printed in numerical or symbol form alongside each point of change of direction. After once setting up the controls, the whole drawing process can be entirely automatic.

Doran Instrument Co. Ltd. (Stand 105)
An auto-titrator for carrying out automatic titrations in the full range of 0-14 pH or a basic e.m.f. range of −200, 0, +1200 mv. will be demonstrated on this stand, together with a Vernier d.c. potentiometer, Mini pH meter for pH and Eh measurements, portable pH indicator, precision Wheatstone bridge, combined reflecting galvanometer and light unit, and a conductivity bridge in which transistors have been utilized for the oscillator and detector circuits to produce a more compact and portable bridge. Six ranges of conductivity and resistance measurement are provided covering a total range of 0·1 to 1,000,000 micromhos and 1 to 10,000,000 ohms. A comparison cell position is also included.

Dynatron Radio Ltd. (Stand 24)
Nucleonic scalers and power units will be among the instruments to be shown on this stand. The power units include a stabilized power unit (N.104/5), the essential function of which is to provide a source of stabilized e.h.t. for G-M tubes and ionization chambers, power unit (N.103) which supplies the high voltage needed by most types of counters used in nuclear physics, nucleonic test set (N.107) designed to provide the necessary services for maintenance of the commonly used instruments in the nucleonics field and timing unit (N.109) for use in conjunction with non-automatic scaling units. The addition of this instrument makes the scaler fully automatic thus enabling counting to be stopped automatically at either a predetermined number of counts or a set time.

Edinburgh University and S.E. Regional Hospital Board, Scotland (Stand 135)
Among the items to be shown on this stand will be a compact free-air chamber for the direct measurement of x-rays in röntgens, plastic phosphor vessels for the scintillation counting of soft beta emitters in liquid form, a pulsometer, a clinical thermometer for hypothermia, two drift-free recording manometers for clinical use, a foetal pulse rate monitor and a clinical blood pressure recorder.

Edwards High Vacuum Ltd. (Stand 125)
In this year's exhibition, the company decided to concentrate on one technique, ultra high vacuum, a subject of particular interest to research workers studying surface phenomena, gas discharges, nuclear fusion and ultra pure thin films. Among the exhibits will be diffusion pumps sytems, getter-ion pumps, instrumentation and seals. A Speedivac vacuum coating plant model 12E8 for producing pure, thin metal films, at very low pressures, will also be shown together with one of the 40 pumping groups being currently supplied to the Rutherford High Energy Laboratory at Harwell for the 7GeV proton synchroton with its automatic instrumentation and control unit.

Ekco Electronics Ltd. (Stand 30)
A wide range of recently developed nucleonic and electronic instruments for use in industry, scientific research, medicine and nuclear reactors will be displayed. In the medical field the following will be shown: scintillation counter type N618 with directional shield type N651, Universal scintillation counter, type N664, automatic scaler type N530 with geiger pre-amplifier type N575 and round lead castle type N662, ratemeter type N600, radiation monitor type N596B, and field ratemeter type N645.

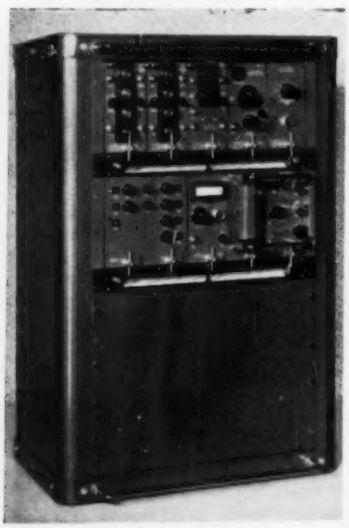
In the scientific field, visitors will be able to see: scintillation counter type N618 with directional shield type N651, Universal scintillation counter type N664, automatic scaler type N 530 with geiger pre-amplifier type N575 and round lead castle type N662, ratemeter type N600, radiation monitor type N596B, field ratemeter type N645, high resistance measuring set type N535, vibrating reed electrometer type N616 and X-Y recorder type E193.

Elliott Brothers (London) Ltd. (Stand 116)
A selection of new microwave components will be incorporated in the demonstration of microwave instruments to be shown on this stand. This includes hybrid impedance transformers, waveguide and coaxial crystal detectors, hybrid couplers, matched leads and short-circuit terminations for waveguide No. 16. There will also be a wide range of electronic instruments. The Computer Division will be demonstrating a new form of magnetic wire matrix storage using transistorized logical elements in the control circuits, together with the Miniac analogue computer Mark II and the G-PAC analogue computer Mark II.

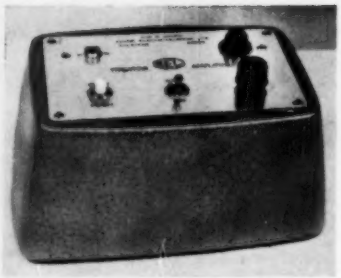
Exhibits will also be shown by the Servo Components Division, the Telecommunications Division, the Electrical Measuring Division and the Industrial Weighing Division.

E.M.I. Electronics Ltd. (Stand 38)
A television camera tube with a 'memory' which enables it to store a picture for several seconds after an object has passed out of view will be one of the new developments to be seen on this stand. The special vidicon pick-up tube has been developed to enable transients to be studied in more detail than would be possible using conventional means. One of the other exhibits on this stand which will attract much attention is the portable contamination monitor. There will also be a representative selection of the peripheral equipment used with EMIDEC digital computers, static displays of photomultipliers, klystrons and other tubes and a working demonstration of a klystron with a WM8 oscilloscope for displaying its output.

English Electric Valve Co., Ltd. (Stand 121)
Exhibits on this stand will include a selection of the company's latest developments among which may be mentioned the K352 high power klystron, the M565 magnetron, an entirely new range of vacuum variable capacitors, cold cathode trigger tubes, the N.1036 parametric amplifier, the AX295 high voltage inverse diode, the BR1143 industrial heating triode and a glow modulator tube, type 1B59, which has been added to the range of E.E.V. Co.'s cold cathode devices.



Typical arrangement of type 200A unitized nucleonic equipment. *Ericsson Telephones Ltd.*



EEI titrator amplifier.

Ericsson Telephones Ltd. (Stand 104)
The company will be exhibiting and demonstrating a wide variety of electronic equipment which they have recently produced or are developing for use in nucleonic and electronic counting, electrical weighing, data conversion and control. Three examples of the many types of counting instruments that can be assembled from E.T.L. sub-units will be used to demonstrate batch counting, summation counting and bi-directional counting. Other exhibits will include analogue digital converters, audio frequency vibration tester, type 189A, and a range of equipment developed by the company from the A.E.R.E. Harwell type 2000 and built in the form of standard dimensioned units which can be assembled to produce nucleonic counting equipment to suit applications from scintillation counting to use with ionization chambers and proportional counters.

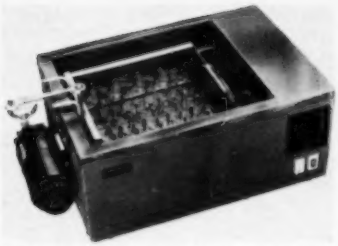
Evans Electroselenium Ltd. (Stand 13)
A range of newly-developed 'EEL' instruments, including the micro-photometer, nephelometer head, recording flame photometer, quantitrator and titrator amplifier will be shown. The titrator amplifier operates in conjunction with a special burette and may be coupled to the titrator and Unigalvo Type 20 to provide for the accurate micro-determination of chloride. The instrument is of interest in clinical laboratories for the analysis of biological fluids such as plasma, serum and cerebrospinal fluid, but is also employed in food, agriculture and metallurgical laboratories. The special burette is fitted with a sealed-in platinum electrode and has a fine silver wire down the outside of the tube. It is provided with facilities for automatic filling from a 100 ml. reservoir and is mounted above the titrator platform when tests are being made.

The nephelometer head has been designed to meet the requirements of those who wish to measure (*a*) samples of extremely low turbidity, or (*b*) the turbidity of coloured solutions. This instrument operates in conjunction with the Unigalvo, Type 20, and combines high sensitivity with the incorporation of optical filters. The samples are contained in ordinary test tubes and compared against a solid standard which is provided for day-to-day reference. A light-tight cover with micro-switch device guards against extraneous light.

Ferranti Ltd. (Stand 26)
The main emphasis of exhibits on this stand will be on electronic equipment and components. On show will be magnetic drums, equipment operating on the principle of photo-electric detection of Moiré fringe patterns, digital voltmeters, silicon semi-conductor devices, ceramic-to-metal seals, industrial and special purpose cathode-ray tubes and valves and transistor inverters. One of the most technically impressive and new exhibits will be a recording extensometer, which has been developed by the company in collaboration with the Aeronautical Directorate Laboratories who were responsible for the design of the extensometer mechanism. It is primarily intended for long term creep testing at high temperatures. Extension of the specimen is detected photo-electrically from Moiré fringes produced by two small sections of diffraction grating. A four-phase signal is fed to a transistor power amplifier which drives one axis of a pen recorder. A synchronous motor drives the other axis, and the extension, greatly magnified, is automatically plotted against time.

There will also be a number of interesting working demonstrations comprising, power control by pnpn devices, operation of a high frequency double-diffused transistor, reading of punched or dotted cards using a miniature matrix of photo-voltaic elements, transistors used as flip-flops and gates and a silicon photo-voltaic sensing element being used to trigger a heavy current relay system. A noteworthy working exhibit will be a parametric amplifier in which a diode is used as a variable capacitor. This will be prominently featured as will the various stages in the manufacture of high-frequency cut-off diodes used for this application.

Flann Microwave Instruments Ltd. (Stand 106)
Exhibits on this stand will be divided into five groups: S band microwave instruments (standing wave meter, precision variable attenuator, variable attenuator, co-axial line to waveguide transformer and signal generator); C band instruments (precision variable attenuator, variable attenuator, co-axial line to waveguide transformer); X band instruments (variable attenuator, wavemeter, co-axial line to waveguide transformer, termination); K band instruments (standing wave meter, wavemeter, termination, precision short circuit); and general instruments (350 Mc/s-9,000 Mc/s. precision co-axial wavemeter, L band (800 to 3,000 Mc/s.) signal generator, wavemeter 900 to 3,000 Mc/s.,



Shaking incubator. *Gallenkamp & Co., Ltd.*

power meter, high voltage klystron power supply.).

The range of frequencies covered by the instruments exhibited is from 800 Mc/s. to 26,000 Mc/s.

A. Gallenkamp & Co. Ltd. (Stand 46)
The apparatus to be shown on this stand will be the adiabatic bomb calorimeter, photoelectric colorimeter, shaking incubator and apparatus for the determination of hydrogen in steel. The adiabatic bomb calorimeter represents the latest development in bomb calorimetry and makes possible two or three determinations of calorific value of solid and liquid fuels and other materials in one hour. With the shaking incubator shaken-culture techniques and other biological, biochemical and chemical reactions proceed with greater speed and repeatability when subjected to mechanical agitation at constant temperatures. The apparatus consists of an accurate thermostatic water bath fitted with a shaking rack and driving motor. The photoelectric colorimeter is a compact direct reading instrument with a stabilized light source. Its response is rapid and a three-position sample holder enables samples to be measured with considerable speed and accuracy. The sliding sample holder will accommodate three samples contained in either optical cells or test tubes and provision is made for storage of eight light filters. The light source is a 6 W. lamp mounted in a reflector and supplied from a constant voltage transformer. Light transmitted by the sample is measured by a 'potted' barrier layer selenium photocell.

G.E.C. Research Laboratories (Stand 115)
An electron-beam parametric amplifier (longitudinal space-charge wave type has been designed to amplify weak signals without increasing the noise level in proportion. Prototypes to be shown will include a digital display tube, a thermocouple signal digitizer, an inductive position digitizer, and an automatic waveguide impedance indicator. The vibrating reed magnetometer to be demonstrated measures the saturation magnetization of small, irregularly-shaped ferromagnetic samples. Recent developments in semiconductor devices and their applications will also be shown.

The General Electric Co., Ltd. (Semiconductor Division) and the M.O. Valve Co., Ltd. (Stand 23)
Among the new transmitting valves on view will be a beam tetrode, TT21, intended for use as an r.f. power amplifier up to 30 Mc/s where over 100 W. are available from a single valve. New radar tubes and additions to the rectifier ranges will also be displayed. The G.E.C. Semiconductor Division's display shows 11 main groups of devices including radar mixer diodes, germanium gold-bonded diodes, silicon variable capacitance diodes, silicon zener diodes, additions to the high voltage silicon rectifier ranges, a new silicon controlled rectifier, germanium low frequency transistors, high speed switching transistors, high frequency drift transistors, and recent examples of point-contact signal diodes and power transistors.

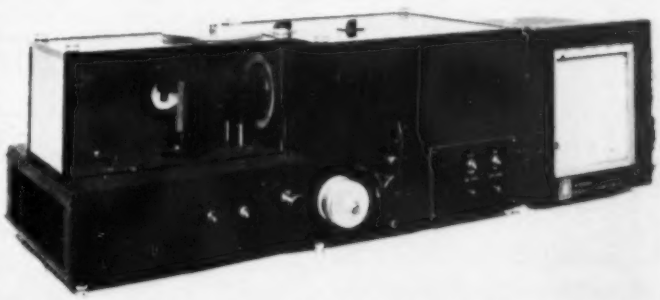
Sir Howard Grubb, Parsons & Co., Ltd. (Stand 98)
Following the successful development of multi-layer filters for the region 4,000 to 8,000 Å, efforts are being made to extend the range to cover the near infra-red to 6μ and later to even longer wavelengths. For the infra-red region germanium and cryolite are materials commonly used to form the layers of alternatively high and low refractive index, and since the layer thickness is $\lambda/4$, where λ is the wavelength to be selected, increasing difficulty is encountered in evaporating the thicker layers required for longer wavelengths. Some experimental filters will be exhibited on this stand. Other exhibits will include an infra-red spectrometer (single beam), double beam grating infra-red spectrometers, a self-balancing infra-red gas analyser and a fixed wavelength analyser using a diffraction grating.

Guy's Hospital Medical School (Stand 132)
The Medical Electronics Laboratory of Guy's Hospital Medical School will be showing two transistor cardiac pacemakers for use with a myocardial electrode, an experimental pacemaker with provision for automatic synchronization of stimulus to the heart's natural rate and various electrodes.

Hanovia Ceramics Division of Engelhard Industries (Stand 45)
A number of exhibits illustrating the wide use of liquid gold and liquid platinum. These are solutions or dispersions of precious metals in organic vehicles which can be applied by means of a brush, spraying or silk screen printing technique. After application, the article being coated is fired in an oxidizing atmosphere to bond the metal to the substrate and burn away the vehicle. These films have very good reflectance, low emissivity and an electrical resistance which is in the range of 0·5 to 250 ohms per square.

On the same stand the **Hanovia Lamps Division of Engelhard Industries** will be showing an autoset mercury vapour meter which measures accurately and indicates by dial readings the mercury vapour content of the air in a room or the level of Hg contamination in other gas systems, and the Hanovia benzole meter which has been developed in conjunction with the laboratories of Benzole Producers Ltd. and indicates the efficiency of benzole recovery from coal gas.

W. Harrison (Stand 3)
There will be two exhibits on this stand —a fluorescence measuring unit which is a combined fluorimeter and colorimeter intended for laboratory work in the textile and paper industries and a fluorimeter suitable for mill or laboratory use. In the first of these the pattern can be illuminated either from an 80 watt mercury discharge lamp or a 12 volt projector filament lamp. The mercury lamp is screened with a black-glass ultra-violet filter and the projector lamp with a special ultra-violet filter which transmits only a small amount of red light. A glass daylight filter (Illuminant C equivalent) is also supplied for the projector lamp so that the instrument can



Single beam infra-red spectrometer. *Sir Howard Grubb, Parsons & Co., Ltd.*

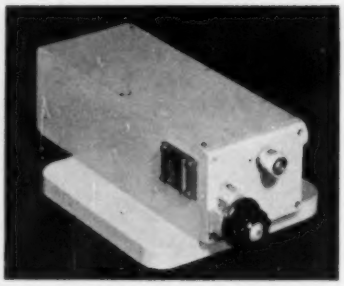
be used as a colorimeter. In the fluorimeter, the sample is irradiated by ultra-violet radiation of wavelength 3655 Å from an 80 watt mercury lamp. Fluorescent light from the sample is received on two photocells placed at 45° on either side of the sample. These cells are connected in parallel and in effect act as a single cell receiving the fluorescent light. They are fitted with pale yellow green glass filters which do not transmit any ultra-violet radiation but transmit freely in the visible region. A third photocell receives ultra-violet radiation directly from the lamp through a graded circular slit cut in a rotatable disc which is motor driven. The slit can be rotated until a balance is obtained between the photocurrents from the cells receiving fluorescent light and the cell receiving ultra-violet radiation. This balance is indicated on a microammeter which carries a phototransistor at the centre zero point below the spear pointer of the meter. The phototransistor acts as a switch to operate a relay which in turn acts as a switch for the motor.

Hatfield Instruments Ltd. (Stand 39)
The major exhibit on this stand will be the radio frequency bridge LE.300. This embodies so many new and useful features that it can be said to represent a new system of measurement. One feature is noteworthy: the construction is rugged and compact, so that the instrument will stand up to continuous usage without a shift in calibration. Furthermore, direct calibration is featured of resistance, conductance, capacitance, inductance and reactance. Thus the bridge gives at once the components of a complex impedance in two and three terminal networks. All of these measurements can be made over the unusually wide frequency range of 15 Kc/s.-15 Mc/s. Above this frequency the accuracy begins to fall off, but the bridge is still useful, within certain restrictions. up to 30 Mc/s.

Hilger & Watts Ltd. (Stand 95)
Among the exhibits to be featured on this stand are:

(*a*) *Prototype of a process-control photometer.*—Developed to measure (continuously or intermittently at choice)

Radio frequency bridge. *Hatfield Instruments Ltd.*



Hilger & Watts grating monochromator.

fluorescence and the absorption and scattering of light in a flowing liquid.

(*b*) *Photoelectric micrometer microscope.*—For use in reading scales and circles where the divisions are marked by lines from 0·0001 to 0·0015 in. in width, and an accuracy over the total range of 0·05 in. of 0·00004 in.

(*c*) *The colourmeter.*—For the measurement of surface colours in terms of three standard stimuli (formerly called primaries).

(*d*) *Photoelectric microptic polarimeter.*—This new instrument has an optical scale which is read visually by a microscope, as in the original version, but a photoelectric setting has been provided for the extinction angle.

(*e*) *Surface-finish microscope.*—An interferometric instrument for measuring the depths of surface irregularities direct to the millionth part of an inch.

(*f*) *The Ultrascan recording spectrophotometer.*—Operating in the ultra-violet and visible regions from 2,000 to 7,500 Å.

(*g*) *A new grating monochromator.*—Of particular value to laboratory workers, microscopists, teachers and others requiring a simple and inexpensive monochromatic light source variable in wavelength from 2,000 to 10,000 Å.

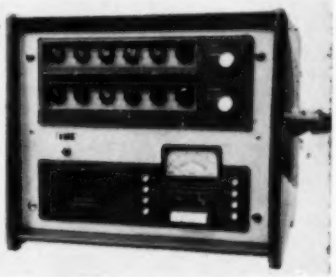
Isotope Developments Ltd. (Stand 34)
Working demonstrations of several instruments will be given on this stand, including the scaler type 1700 (an automatic counting equipment), a precision ratemeter giving both linear and logarithmic display, an '1800' series counting equipment, a scintillation counter type 661, a scintillation counter type 700, Gammalarm type 666 for operating an alarm when the radiation intensity exceeds a pre-set value, and the Vibreed 1880—a dynamic capacitor electrometer for measuring very small direct currents in high impedance circuits.

Johnson, Matthey & Co. Ltd. (Stand 48)
The display on this stand will include high purity metals and alloys for semiconductor devices, silvered mica capacitors, silver metallizing preparations, plated finishes, noble metal resistance wire, Platinax II permanent magnet alloy, Mallory 1000 and the use of platinum metals in temperature measurement.

Joyce & Optica Group (Stand 69)
Joyce, Loebl & Co., Ltd., will be showing a Chromoscan universal recording and integrating reflectance densitometer, a Model G microdensitometer, a Chromocord differential colour analyser, transistorized lamp supplies and a number of optical attenuators. On the same stand **Optica United Kingdom Ltd.** will be showing four items: a double-beam ratio-recording reflectance spectrophotometer, an atomic absorption spectrophotometer, a spectro-polarimeter attachment and one of the monochromators on show will be used to give a continuous demonstration of stray light in spectrophotometers. **Power System Computors Ltd.** on this stand will be showing Blackburn transformer analogue type a.c. network analysers.

Labgear Ltd. (Stand 35)
A non-overloading linear pulse amplifier for flow counters and scintillators which has been designed with particular attention to its use in spectroscopy will be shown on this stand, together with a gas flow counter which may be used in either Geiger or proportional regions by changing the counting gas and operating potential, a pulse spectrum analyser D.4141, an automatic sample changer D.4137, a stabilized EHT unit D.4140, a Trochotron pre-scaler D.4138 and an automatic timing control unit D.4139.

Lintronic Ltd. (Stand 41)
Four prototype units and one in production will be featured on this stand. The prototypes are a two-film yaw meter, a 20 position unobstructive turbulence detection unit, a pulsating flow transmitter and a high speed analogue-digital converter. The exhibit in production is a water-cooled pressure transducer for high frequency measurements capable of withstanding gaseous-medium temperatures in excess of 3,000° C.



Scaler 1700. *Isotope Developments Ltd.*

Claude Lyons Ltd. (Stand 37)
The exhibits on this stand may be divided into three main groups: general, a.c. automatic voltage regulators and stabilizers and d.c. supplies of various types. Under the classification 'General' will be seen an eye movement recording system, unit bridge oscillators, motor speed controls and voltage and current relays. Under the second heading comes an automatic voltage regulator for 400 c/s. operation, electronic voltage stabilizer, an automatic step regulator, an automatic voltage regulator using motor generator, and a high power servo-mechanical voltage regulator. The final classification will include unit power supplies, servo-mechanical voltage stabilizers and a magnet power supply.

Marshall of Cambridge Electronics Ltd. (Stand 76)
A pulse height analyser type HS.100 of completely new design and possessing all the facilities normally required in a kicksorter for nuclear research will be one of the exhibits to be seen on this stand. Another instrument for nuclear research to be shown is the magnetic pulse recorder type MPR 103. Other exhibits on this stand will be a transistorized ring scaler, a twin channel pulse generator and automatic uranium assay equipment which determines the uranium content of ore samples in a period of less than 25 seconds.

Medical Research Council (Stand 139)
Thirteen items will be featured on this stand as follows: Size separating sampling instrument for airborne particles, the Conicyle, an impaction sampler for size grading air-borne bacteria-carrying particles, sampling tubes for continuous gas analysis within the lung, a pressure or temperature sensitive telemetering transmitter capable of being swallowed for the purpose of measuring temperatures and pressure in the digestive tract, a new design of fluid flow meter, a scintillation counter for gas liquid radio chromatography, centrifugally accelerated paper chromatography, polarograph, a ballistic bomb calorimeter, a portable high-pressure ionization chamber for measuring background radiation, a simple analogue digital converter with display and print out facilities and a completely transistorized miniature capacity pressure gauge system.

Megatron Ltd. (Stand 16)
A range of different shapes and sizes of mounted and unmounted selenium photocells with different spectral characteristics will be shown, together with improved 'potted' selenium cells, tropical fast and resistant to chemical attack, besides the well-known range of cosine corrected light meters C1-C3 and C5a, an integrating light meter developed in co-operation with National Institute of Agricultural Engineering will be exhibited. Other items will be a colour temperature meter and samples of three different types of coatings on glass which are being used on antistatic instrument windows and for de-misting and defrosting, electro-luminescence, etc.

Mervyn portable potentiometer recorder.

Mervyn Instruments Ltd. (Stand 99)
The existence of transistors and other solid state devices has enabled the physical size of many pieces of apparatus to be substantially reduced. The instrument to be shown here is the first example of transistor technique to be completely applied to the self-balancing potentiometer recorder. In the device shown the chopping unit uses transistors as does the amplifier, demodulator and output stages. The voltage reference is a Zener diode and the rectilinear potentiometer is driven from a miniature d.c. motor. The performance of the instrument is fully equal to that of the larger conventional instrument and possesses the considerable advantage of portability. It is completely self-contained and no accessories are required. Other items on this stand will include a homodyne amplifier and radiation modulator, a square wave polarograph Mark III, examples of synthetic crystals and the Mervyn-CERL sulphur dioxide recorder.

Mining Research Establishment (Stand 124)
Exhibits on this stand will be supplied by the Mining Research Establishment at Isleworth (precision gas pressure regulator for low flow rates, a method of measuring the tensile strength of brittle materials, a mechanical trace reader, a photoelectric densitometer for evaluating samples of respirable dust from mines and an intrinsic safety check tester for pit use), the Scientific Department at Queensborough House (high speed optical scanning apparatus) and the Coal Research Establishment at Cheltenham (the C.R.E. density meter, a bunker level indicator and a slurry density meter).

Ministry of Power (Stand 128)
The exhibits to be shown on this stand are all related to the study of methane in coal mines which is one of the key subjects in mines safety research—certain concentrations of methane in air can be ignited by a spark energy of less than one millijoule. As methane has a density of 0·6 relative to air, it tends to accumulate in layers flowing near the roofs of underground roadways, or in the roof cavities that occur occasionally when the normal supports fail to carry the weight of broken or faulted strata. Much attention is being paid to these dangerous accumulations of gas and to ways of measuring their concentration and of dispersing them.

Murex Ltd. (Stand 52)
A wide range of items fabricated in molybdenum, tungsten, tantalum, niobium and zirconium will be shown. These items will include various shapes which have been fabricated in tungsten metal by spinning. Electron beam refined rods of these metals will be shown together with arc melted ingots of tantalum and niobium. Elements for high temperature heating units fabricated in molybdenum and tungsten will be exhibited and many items of corrosion resistant chemical plant fabricated in tantalum are available. Sintered Comal-

S.M.R.E. methanometer. *Crown Copyright: S.M.R.E., Ministry of Power.*

loy, a permanent magentic alloy which can be machined by conventional methods prior to final heat treating is now in production and sintered soft iron pole pieces for use in magnetic circuits are on display. Many examples of sintered permanent magnets and Sincomax magnets will be exhibited.

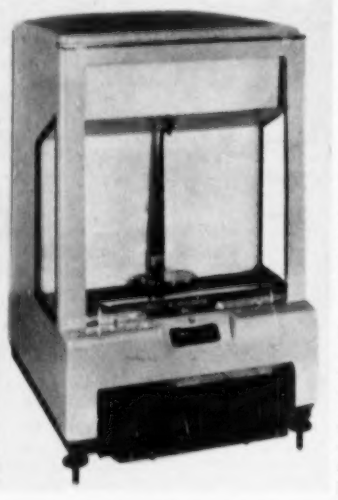
National Research Development Corporation (Stand 31)
A simple micromanipulator which has been designed for use under the medium power of a microscope will be shown on this stand. It permits fine and fairly rapid movements in all three planes and allows the working point to be rotated. It is provided with means for interchanging tools and also to use forceps in addition to the more usual scalpels and needles. Other exhibits on this stand will be a magnetic susceptibility meter, a digital voltmeter, an indium antimonide displacement transducer, a wide range speed indicator and an automatic vacuum sampler.

New Electronic Products Ltd. (Stand 7)
A new recorder providing a direct writing instrument with facilities for recording up to 36 variables with six datum lines and two event channels will be featured on this stand. Since last year's Exhibition, a great amount of development work has been concentrated on the range of galvanometers and as a result of a new manufacturing technique, sensitivities have been vastly improved on all instruments to which this technique has been applied. Examples of galvanometers produced by this new technique will be shown, together with further developments of the N.E.P. range of differential inductance pressure transducers.

Newport Instruments (Scientific and Mobile) Ltd. (Stand 89)
The spectrometer to be exhibited operates at a frequency of 9,500 Mc/s. and a magnetic field of 150 to 8,000 gauss. The instrument is intended for routine chemical analysis of free radicals at room temperature. An alternative metal Dewar flask containing a cavity can be provided for work at liquid oxygen and liquid helium temperatures. The magnet gap will accommodate Dewar flasks not exceeding 2¼ in. outside diameter. The magnet and power supply are standard Newport Instruments production units: the 7 in. electromagnet type E (wide yoke) and the current stabilized power supply unit type B. The waveguide assembly consists of fully compatible sections of W.G. 16. It is composed almost entirely of standard units which can be readily interchanged or replaced to suit individual experiments. The display and control circuits are almost fully transistorized and are made up of a number of standard units. The output spectra are presented as a permanent paper record.

Newport Instruments 7 in. electromagnet type E, rotating base AE, current stabilized power supply unit type B.

Nuclear Enterprises (G.B.) Ltd. (Stand 2)
This display will include the new tritium carbon 14 counting assembly NE 8301 which provides counting under daylight conditions at room temperatures with efficiencies obtainable up to 40 per cent for tritium in water and 90 per cent for Carbon 14. Also on exhibition will be the precision scanning scintillation spectrometer NE 8601 which is a continuously scanning and recording single channel pulse height analyser of the highest possible performance, the new NE 5401 ratemeter with its ranges of 30, 100, 1,000, 3,000 and 10,000 counts per second, and indicating accuracy of 1 per cent of reading, together with an overall stability of better than ± 1 per cent, and a range of new scintillators.



Oertling single pan balance.

L. Oertling Ltd. (Stand 110)
A wide selection of balances will be shown by this company, among which will be the quartz fibre ultra micro balance designed to weigh loads of up to 0·5 g. to an accuracy of 0·1 microgram, a semi-automatic balance for weighing loads of up to 2 Kg. to an accuracy of 0·1 g. using a system of mechanical amplification of the pointer movement to provide a large easily read scale, additions to the range of one pan instruments, two new models of two pan balances and a new series of adjustable analytical weights in non-magnetic stainless steel. Modern production methods have resulted in the manufacture of these weights to within N.P.L. Class A tolerances at a price which enables them to be used for all laboratory purposes. They replace completely the traditional brass weights.

Optical Works Ltd. (Stand 120)
On this stand can be seen a small quartz spectrograph—a folded version of the more conventional instrument and using one of the new types of fused quartz—a portable spark source designed primarily for schlieren photography and a selection of new components of interest to physics, including optical components, mirror mounts and other special optical bench fittings. A working wind tunnel complete with a schlieren system will be shown with the co-operation of Plint & Partners Ltd. The tunnel works on the induction principle from an air compressor and reservoir. A typical aerofoil section will be used for demonstration purposes.

W. Ottway & Co. Ltd. (Stand 92)
The erect-image smoke density telescope will be one of the exhibits on this stand. This instrument is a low power prismatic erecting telescope which combines the image of the smoke with two filters in a common plane. The reflector photometer which measures the performance of reflectors used on vehicles and road signs will also be demonstrated on this stand, together with a folding two-power stereoscope, oscilloscope lenses and a new light weight survey level.

Panax Equipment Ltd. (Stand 85)
Scintillation counters which have been extended to cover well counting, end-on counting, annular sample counting, end window counting using planchets, liquid flow counting and directional counting will be displayed by this company. Also on show will be a scintillation castle, pulse amplifier, level indicator, high sensitivity gamma prove, and counting equipment.

Paton Hawksley Electronics Ltd. (Stand 78)

Among the gratings to be shown on this stand will be diffraction gratings for spectroscopy, gratings for metrology and radial gratings and divided circles, together with a selection of graticules of standard and special pattern. Another exhibit will be a measuring microscope consisting of a substantial base supporting a ball and vee slide. Sense of direction and distance are derived from photoelectric cells recording the passing of regular patterns. The finer measurements are in the form of grids or diffraction gratings and the coarser intervals are based on sine wave producing patterns. The reading head and microscope are integrated and are moved along the slide coarsely by friction and finely by screw. The sensing head is bi-directional and is unaffected by vibration or speed of movement. The display unit consists of a panel containing an inch counter and four oscilloscopes, each presenting in circular form one decade, as, one-tenth of an inch, one-hundredth of an inch, one-thousandth of an inch, each circular scale being divided into ten parts. The trace of spot positions on the display unit indicate precisely the position of the microscope in relation to the fixed grating and sine wave patterns. The system therefore possesses indefinite memory regarding position.

Perkin-Elmer Ltd. (Stand 8)

An instrument designed for the rapid measurement of spectra in the 12·5-25μ region will be shown on this stand. Dispersion is by a potassium bromide prism, and the slit and wavelength mechanisms are programmed to give the required spectrum automatically in about six minutes. With this speed of recording, the resolution is four wavenumbers, or better, over most of the range and the noise level not greater than 1 per cent. Recording is linear in transmission and wavelength, but special pre-printed charts are available for reading off absorbance or wavenumbers. A full range of accessories is available. The gas chromatography equipment on this stand will show the incorporation into a standard Perk-in-Elmer Fracto meter of certain newly developed accessories which extend the range of the instrument in sensitivity and separating power. A further exhibit will be a recording ultraviolet and visible spectrophotometer covering the wavelength range from 190 to 750 mμ.

G. V. Planer Ltd. (Stand 53)

Indium antimonide and indium arsenide Hall elements of novel design will be shown, utilizing extremely thin semiconductor sections and hence allowing a minimum gap in the controlling magnetic circuit. Examples of various semiconductor alloys for use in thermoelectric cooling devices will also be displayed, together with a new procedure for monitoring moisture content in high density fluorinated hydrocarbon oils by a radioactive isotope method. There will also be a selection of photographically produced printed circuit elements on glass or ceramic base. The series comprises new configurations of oxide film step-potentiometers and gold-coated copper circuits on borosilicate glass base.

Printing, Packaging and Allied Trade Research Association (Stand 44)

Two items of PATRA's research equipment, a Sheen abridged spectrophotometer and an apparatus for measuring the penetration of ink into paper, will be shown. The spectrophotometer is used at PATRA for colour measurement of papers containing optical bleaches which are designed to fluoresce in daylight. It is fitted with a 300 watt 'Neron' high-pressure xenon arc lamp which, with a glass filter, matches daylight through the visible and ultra-violet regions of the spectrum. The spectrophotometric curve is drawn from reflectance readings obtained.

The penetration apparatus is a laboratory printing unit for studying the penetration of ink into paper. It is built to operate hydraulically an inflatable rubber membrane to print a solid area. Hydraulic pressure up to 1,200 lb./per sq. in. for a duration as short as 0·01 second can be employed for printing. The extent of ink penetration in printing is measured through a photocell in terms of the percentage fall in light reflected from one side of the paper as ink penetrates into the other side.

R. B. Pullin & Co., Ltd. (Stand 72)

The company will show samples from their range of low voltage wound field a.c. and d.c. motors and the new range of permanent magnet d.c. motors in International frame sizes; Pullin and Pullin Kearfott a.c. Servocomponents and shown for the first time Size 15 and 18 motor generators; transistorized amplifiers and magnetic output transformers; and the Aldis Digilite optical, projection-type in-line digital indicator.

W. G. Pye & Co., Ltd. (Stand 93)

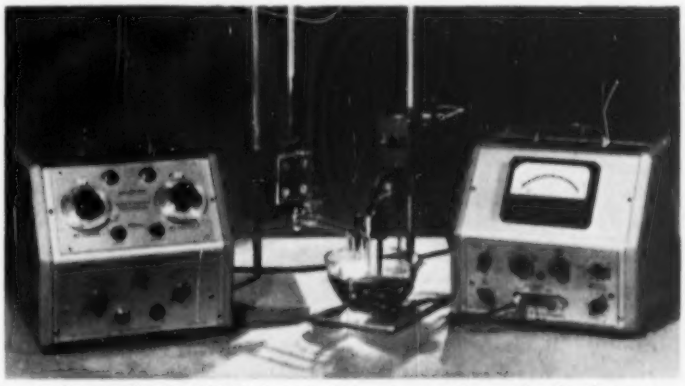
An automatic titrator-controller of new design will be demonstrated together with a Pye pH meter. The new instrument features two independent electronic relay circuits, each of which can be set up to operate at any point in the 1 milliamp input current range. Since its introduction in 1958 the argon chromatograph has achieved an excellent reputation in a very wide range of applications from routine analysis to fundamental research. The latest model of this instrument will be demonstrated together with the complete range of accessories which has recently been developed. These include a variety of injection systems for liquids and gases. Other exhibits will include pH meters, rotary burettes, stabilized power supply units, galvanometers and potentiometers.

Racal Instruments Ltd. (Stand 17)

A new transitorized universal counter timer which has the added advantage of a variable time base will be shown on this stand, together with a new transistorized pre-set counter which has been specially designed for industrial use where high inherent reliability is essentail. Other exhibits on this stand will be a digital volt-ohm meter, a V.H.F. converter, and ranges of transistorized plug-in units and transducers.

Reading University, Department of Physics (Stand 134)

A student grating spectrograph designed for teaching undergraduates in the final year of a Special Honours course will be shown. It is a fairly straightforward Littrow design using a grating having a ruled area 57 mm. × 48 mm. with 15,000 lines per inch and a radius of 1 metre. The dispersion is 17Å/mm. Apparatus for studying radiation damage will also be shown. In order to



Pye autotitrator with Universal pH meter set up for routine titrations.

study the electrical properties of germanium surfaces while clean, or during the process of contamination, it is desirable to be able to expose a fresh plane surface in a vacuum of better than 10^{-9} mm. Hg. This is achieved in a continuously pumped system with diffusion and ion pumping, using the glass jig shown. The orientated specimen is bent by a magnetically operated lever until cleavage starts from a small diamond scratch and then runs freely, though imperfectly, along a (111) plane. Because of healing effects associated with the vacuum baking (430° C. for many hours) the diamond scratch must be applied in the vacuum system after baking. The diamond tip lever employed for this purpose is again magnetically operated. A surface obtained in this way will be shown.

The Research Association of British Rubber Manufacturers (Stand 44)

This Association will be showing on the D.S.I.R. stand and their exhibits will number five; these are intended to show how an electronic method of force measurement that they have developed can be used in a variety of physical testing instruments. The five exhibits will comprise an electronic tensile tester, a dynamic tester, friction apparatus, a rope friction machine and an intermittent stress relaxation apparatus. Another exhibit of importance to the rubber industry is the Shawbury curometer by which it is possible to estimate the time required to vulcanize rubber compounds to give the maximum degree of cross-linking.

Salford Electrical Instruments Ltd. (Stand 22)

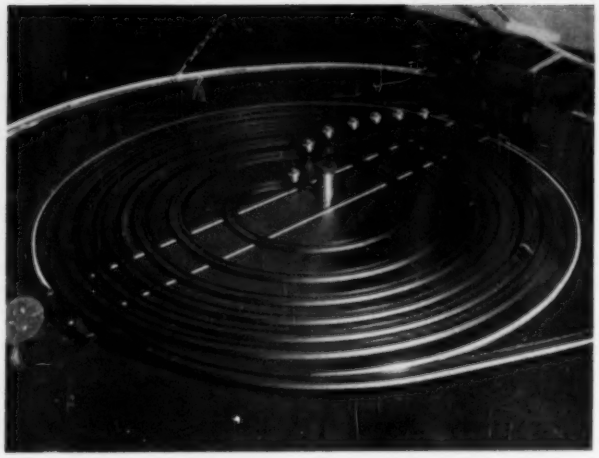
A gamma ray level indicator equipment was originally developed for the N.C.B. to provide remote indication of the level of coal within pithead and underground bunkers, but various types of gamma source and detector leads have been developed which allow it to be used for a variety of other industrial applications involving both solids and liquids. Examples will be on show, together with a remote indicating system for pressure measurement with long scale indicator and a remote indicating recorder for pressure, displacement and level measurement.

Sangamo Weston Ltd. (Stand 96)

A transistor relay which has been developed primarily to replace the high speed polarized relays used in the tachometer computer box will be displayed, in addition to a jet pipe temperature test set and a detector test set designed to test the Sangamo Weston ice warning system for aircraft.

The Science Museum (Stand 50)

Two exhibits will be shown—a mechanical model showing the principle of the cyclotron in which a series of steel balls roll round a spiral path and receive repeated accelerations by rolling down a ramp connecting two oscillating metal plates which represent the 'dees' of an actual cyclotron, and a mechanical model illustrating the principle of the cascade generator for accelerating atomic particles. This shows a mechanical analogy of the way in which a particle suffers repeated accelerations by means of a linked system of capacitors and rectifiers.



Science Museum Cyclotron model.

Servomex Controls Ltd. (Stand 11)

A transfer function analyser, type 46, which is the prototype of a comprehensive instrument for determining the dynamic frequency response of servomechanisms and automatic control systems, will be shown, together with fully transistorized d.c. stabilized power units, motor controllers, and armature supply units. Products of an associated company, **Feedback Ltd.**, will also be displayed on this stand and will include a servo system intended for demonstration purposes and student use, a servo analogue demonstration and analogue demonstrations to illustrate the principles of root locus analysis.

The Solartron Electronic Group Ltd. (Stand 94)

Over 20 instruments new to the Exhibition will be shown on this stand, among which may be mentioned a computer servo multiplier, a computer servo resolver (both additions to the analogue computing range), computer general purpose diode function generator, computer logarithmic amplifier, digital voltmeters, precision data amplifiers, digital data recorders, a vacuum dome x-ray spectrometer, pressure transducers, a pressure scanning valve and chokeless power supplies. Other equipment previously shown, now modified and improved, will include an automatic keyboard instructor, the Minispace 10 amplifier analogue computer and a multi-channel tape recorder/reproducer for data recording.

Swiss Physical Society and Swiss Office for the Development of Trade (Stand 130)

Six Swiss firms will be showing on this stand as follows:

Landis & Gyr A.G.—Equipment for the control of radioactive contamination in liquid consisting of a detecting unit and a measuring unit.

Metrohm A.G.—The Metrohm potentiograph E336 for the automatic recording of titration curves, primarily potentiometric titrations of all types as well as dead-stop titrations. By using auxiliary equipment, conductometric, amperometric, photometric and coulometric titrations can also be carried out.

Emile Haefely & Co., Ltd.—A model of a 4 mv. ion accelerator in a pressure tank—this is intended for nuclear research of high accuracy.

Trüb, Tauber & Co., Ltd.—The electron diffractograph KD3 which has been designed as a universal apparatus and is able to solve any diffraction problem. By use of additional parts the diffractograph can be adapted to the special needs of its users.

Ebauches S.A.—Two exhibits will be shown—a fully transistorized 100 VA. ampifier fitted with a 35-65 c/s. oscillator and a panel comprising impulse-counting units.

Oerlikon Engineering Co.—Three exhibits will be shown comprising photos of small laboratory magnets, a section of a quadrupole magnet and a section of a bending magnet.

Metrohm Potentiograph E336. *Swiss Office for Development of Trade.*

Techne (Cambridge) Ltd. (Stand 126)

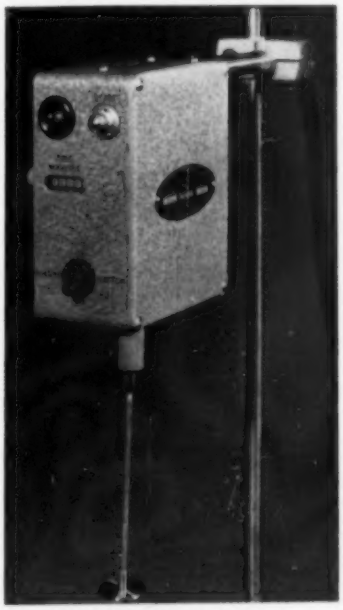
A wide range of instruments will be shown on this stand including the Centichart, constant level device, stainless steel water bath, Tempunit, gelation timer and goniometer. Of particular interest will be the Tempunit (this was the subject of a Test Report, *Lab. Practice*, **8**, 321) the latest model of which incorporates all the features of temperature control within ± ·05° C. over the range 15° C. to 95° C. in a new and more attractively streamlined case, and the gelation timer by which gelation time, defined as the time taken at a stated temperature for a liquid to gel, can be measured accurately without the test being under constant supervision. The paddle reciprocates with a period time of one minute until the liquid reaches the stage where the consistency is sufficient to support the paddle. The minute counter is immediately stopped and a warning light is illuminated to attract attention and the time taken for the liquid to gel can then be read from the counter in minutes.

J. Langham Thompson Ltd. (Stand 47)

From the camera laboratories will be shown two new recording cameras, the Series 410 for use in conjunction with most standard oscilloscopes, and the Series 420 which has been designed exclusively for use on a Vickers projection microscope. Also on show will be an electronic automatic exposure controller and an automatic film processor capable of developing, fixing, washing and drying 35 mm. film at a speed of 1 in. per second. Among the new transducers for the measurement of acceleration displacement, force, pressure and vibration, special mention must be made of an accelerometer capable of measuring static and dynamic accelerations, within the range of ± 1 g. to ± 100 g. Of especial interest in the group of new pressure transducers are the new potentiometric types which are designed to meet severe environmental requirements for high-level noise-free linear output. From the electronics laboratories come a number of new electronic measuring instruments intended for use with strain gauge and inductive transducers; designed on a modular principle, these instruments are completely transistorized. Among a wide variety of voltage regulating equipment and power supplies, interest will largely be centred on a number of new models incorporating the latest transistor circuit techniques.

J. W. Towers & Co., Ltd. (Stand 15)

The five main exhibits to be featured on this stand are the automatic standard distillation apparatus, micro-scale automatic countercurrent apparatus for the separation by multiple extraction of milligramme quantities of alkaloids, amines, aminoacids, antibiotics, peptides, steroids, vitamins, etc., automatic fraction collector for use in chromatographic analysis, etc., based on the design of the Low Temperature Research Station, Cambridge, a rotary fim evaporator which utilizes the principle of spreading a thin film of liquid over a large surface area and subjecting it to reduced pressure and the Model 60 analytical balance—a precision swing balance with a capacity of 200 g. in each pan and sensitivity of 0.1 mg. per half scale division.



Techne gelation timer.

Townson & Mercer Ltd. (Stand 82)

The Houillon viscometer assembly—a system of viscosity measurement by flow through a capillary tube which has considerable advantage over normal U tubes—will be one of the exhibits to be seen on this stand. Other exhibits will include a low temperature thermistor bridge controller, a fibre glass humidity cabinet (the result of several years' work to adapt a new technique of glass fibre and resin construction to laboratory apparatus) and an entirely new and very simple device comprising a magnifying reader for thermometers which uses a good quality rectangular lens so that a considerable length of the thermometer or burette stem can be seen at one glance, thus greatly simplifying operation compared with the usual viewers. Distortion is very slight and the lens is held in a special rubber moulding which also holds a stainless steel wire support which automatically clamps the lens at the correct distance from the thermometer.

20th Century Electronics Ltd. (Stand 6)

The following are some of the interesting exhibits selected from the products to be shown on this stand:

Ceramic-metal vacuum seals.—Designed for use at very high temperatures up to 800° C.

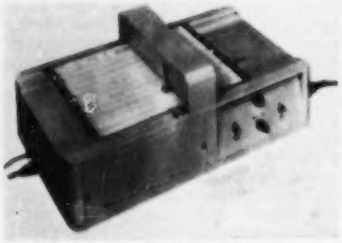
Miniature fission chambers.—Developed for investigation into reactor fuel elements and capable of operating at temperatures up to 600° C.

Mass spectrometer leak detector.—Designed for the detection of leaks in vacuum and pressure vessels.

Scintillation chemicals.—Boron chemicals of high purity for incorporating into neutron scintillators, including boric acid and methyl borate.

Ultrasonoscope Co. (London) Ltd. (Stand 73)

Various examples of flaw detectors will be shown on this stand together with sub-miniature probes for use in con-



Unicam flat-bed recorder.

fined spaces where inspection by the standard range of probes is inconvenient or impossible, transverse wave probes and point probes. On the same stand **Glass Developments Ltd.** will be showing apparatus for the investigation of atmospheric pollution by the lead peroxide and volumetric methods and an ammonia Maser type GDM. 3.

Unicam Instruments Ltd. (Stand 87)

A spectropolarimeter comprising an assembly of units from the Unicam Unit range of spectrometric equipment will be one of the items featured on this stand. Another exhibit will be the SP.900 flame spectrophotometer which has wide potentialities both for advanced research and for routine quality control, and the SP.100 infra-red grating spectrometer using a double monochromator consisting of a grating system with two gratings ruled at 1,500 and 3,000 lines/inch, together with a conventional prism monochromator. A new item will be a flat bed recorder which has been primarily designed for spectroscopic purposes, a novel feature of which is the chart bed which is driven past the pen. The recorder will be shown in operation as a slave recorder to the SP.100 spectrometer by means of a synchronous link between the recorder and the wave-number cam spindle of the spectrometer.

United Kingdom Atomic Energy Authority (Stand 86)

The Atomic Weapons Research Establishment, Aldermaston, the Chemistry Division, Woolwich and Harwell, the Electronics Division, Harwell, the C.T.R Division, Harwell and the Isotope Research Division, Harwell will be showing on this stand. From this latter division will be shown a radioisotope x-ray spectrometer in which a radioactive source of x-rays is used to excite fluorescent x-rays in the sample and these are analysed with a proportional scintillation counter. Because of the small path length between source, sample and detector, only a very low activity sources need be employed. Also to be shown is gamma ray flux measurement using cadmium sulphide single crystals. The change in conductivity of cadmium sulphide single crystals when irradiated with gamma radiation has been used as the basis of a simple radiation detector for measuring dose rates in the range 1 to 100 r/hr. Two designs of instrument will be exhibited. In one the crystal is at one end of a short probe which is an integral part of the indicator unit and in the second the crystal is mounted at the end of a length of cable so enabling it to be inserted into otherwise inaccessible cavities.

Venner Electronics Ltd. and Venner Accumulators Ltd. (Stand 12)

Venner Electronics will show a range of transistorized timing, counting and frequency measuring equipment, covering counting speeds up to 1 M.p.p.s., timing units of 1μS. and frequency measurement to 1 Mc/s. Of particular interest is the combination of the TSA 53 in-line readout frequency meter with the TSA 65 high speed printer. There is also a new expanded scale analogue frequency meter type TA 501 covering frequency measurement from 3 c/s. to 300 kc/s. Punched-tape readout will be demonstrated, as well as an all-electronic digital clock. Examples from the Venner range of plug-in transistorized stages will also be on display—there are now over 40 types currently available.

Venner Accumulators will show latest developments in a range of lightweight silver-zinc accumulators of the primary activated type which are inert in storage.

W. Vinten Ltd. (Stand 100)

Various types of camera will be on display, including the Mark I and Mark II 16 mm. scientific cameras, two types of 16 mm. high speed cameras and the 70 mm. C.R.T. recording camera which provides a large sharp negative of high quality. The camera is pulse operated by hand or intervalometer and requires a power supply of 24 volts d.c.

The Water Research Association (Stand 44)

These exhibits will form part of the display on the D.S.I.R. stand and will include an instrument for the location of leaks in water mains and apparatus for the accelerated testing of plastic pipes. In the first of these the apparatus consists of a Rochelle Salt pick-up, matched to a low-noise 120 db. amplifier and a trigger circuit which can cause a lamp to light. In the apparatus for testing plastic pipes, nitrogen cylinders at constant temperature provide the required pressure which is transmitted to the pipe through a hydraulic accumulator—a steel bomb containing a rubber bag connected to the nitrogen, and water, which also fills the pipe under test. As the plastic yields to the pressure, the gas bag expands at the expense of the water. The accumulator, being suspended from a spring balance—its loss of weight measures the yield of the pipe. On failure of the pipe, the expanding bag closes a valve and seals the apparatus.

W. Watson & Sons Ltd. (Stand 81)

The main exhibit on this stand will be the Barnet ventilator—a time cycled intermittent positive pressure respirator. Its use permits infinitely variable adjustment of the inspiratory/expiratory ratios between 9:1 and 1:9, respiratory rates between 12 and 60 respirations per minute at an inspiratory period 0·5 sec. and peak bronchial pressures between 5 cm. and 30 cm. of water pressure. Also to be shown will be a range of microscopes designed for applications in science and industry.

Wayne Kerr Laboratories Ltd. (Stand 102)

This distance meter DM100 operating in conjunction with non-contacting probes for the direct and continuous measurement of distances between 50 micro-inches and half an inch will be one of the exhibits on this stand, together with the electronic micrometer B.721 with its non-contacting probe so attached to a microscope that it measures any movement of the objective relative to the slide platform. A range of microwave components will also be shown.

Westminister Hospital, Physics Department (Stand 138)

An apparatus for the two-stage cooling to —79° C. of human bone marrow will be shown. The ampoules of marrow cell suspension are placed in a vessel of methylated spirit, the lower part of which is insulated. The vessel is lowered in two stages into a Dewar flask of methylated spirit maintained at —79° C. by solid carbon dioxide. In the first stage the depth of immersion is just less than the height of the insulating jacket, and slow cooling is obtained. At —15° C. a thermostat inside the vessel closes, and by means of a simple control circuit the vessel is lowered to produce rapid cooling.

Wool Industries Research Association (Stand 44)

The two main exhibits on this stand (D.S.I.R. stand) will be an assembly for the automatic chromatography and assay of mixtures of radioactive substances and a buckling spring calibrator for thread strength. The first apparatus is designed to collect fractions of the effluent from a chromatographic column, to evaporate these fractions to dryness on small metal trays, to present the fractions in turn to an end-window G.M. counter, and to record the counts obtained. The buckling spring calibrator provides a rapid method of calibrating yarn strength machines under dynamic conditions. The friction and inertia forces are the same as in the yarn strength test. At a critical load, the strip buckles and registers in the same way as when a thread breaks in a strength test. The reading is then compared with the known buckling strength of the strip which is determined once and for all by attaching weights to the hook.

News from the British Association of Chemists

ANNUAL GENERAL MEETING

THE 42nd Annual General Meeting of the B.A.C. was held at the Midlands Hotel, Birmingham on Saturday, December 12, 1959. The following Officers and Councillors were elected for 1959/60:

President: J. Wilson, C.B.E., M.C., M.Sc., F.R.I.C., F.I.R.I.

Vice-Presidents: G. T. Gurr, F.R.I.C.; R. J. Mollard; L. E. Puddefoot, B.Sc.; N. Sheldon, A.R.C.S., F.R.I.C.

Hon. Treasurer: A. T. Healey, Ph.D., D.I.C., F.R.I.C., A.M.I.Chem.E.

Hon. Secretary: E. H. G. Sargent, A.C.G.F.C.

Hon. Registrar: H. L. Howard, B.Sc., A.R.C.S., D.I.C., F.R.I.C., M.I.Chem.E.

Trustees: C. S. Garland, B.Sc., A.R.C.S., F.R.I.C., M.I.Chem.E.; H. T. F. Rhodes, M.I.E.I.; Miss W. Wright, B.Sc., A.R.I.C.

Hon. Editor: H. Warson, B.Sc., F.R.I.C.

General Councillors: C. H. Bowyer, B.Sc., A.C.I.P.A. F.R.I.C.; G. A. Dunn, A.R.I.C.; G. Robertson; H. Warson B.Sc., F.R.I.C.

The Section Councillors, who had been elected previously by the sections concerned, were as follows:

Birmingham (*West Midlands*): J. E. Gregory, B.Sc., Ph.D., F.R.I.C.

Manchester: H. Batley, B.Sc., A.I.M.; J. Rickman.

Notts. & Derby: A. J. Wesson; E. Stonehouse.

Liverpool: T. Q. Matthews; C. J. H. Wylie.

London (*Area* 1): J. A. Newell; V. J. Potter.

London (*Area* 2): E. H. G. Sargent, A.C.G.F.C.; W. A. Phillips.

Yorkshire: J. G. Wain.

Dr. Morris Robinson and Mr. G. C. Woodward were elected *Hon. Auditors*.

The *Report of Council for* 1958/59 which was presented to the meeting, included the following items:

Chemists in Nationalized Industries.—It is fairly well-known that chemists working for some nationalized industries find themselves in a very unfortunate position in that few, if any of them, were actual members of a trade union at the time the industry was nationalized. As a result the B.A.C. is not represented on the National Joint Councils for the industries, which are the bodies which negotiate salaries and conditions of employment. Chemists therefore have found themselves compelled to join unions which are quite unable either to appreciate or to present a case for the chemist, with the result that conditions for chemists in some nationalized industries are inferior to those of chemists employed outside the nationalized industries. In consequence the turnover of staff is large and the number of well-qualified members is correspondingly low. This is particularly the case in the gas industry, and during the past 12 months the B.A.C. has put in a tremendous amount of work trying to get this state of affairs amended.

Legal Aid.—The Association's free legal advice service continues to be used frequently by members, who have received advice and material assistance in a variety of matters, including service agreements and termination of appointments without sufficient notice.

Salary Scales.—The Salary Scales Committee issued a revised edition of the Scales, dated January 1959. The B.A.C. Scales continue to interest employers and requests for copies are continually being received. From time to time, advertisements of chemical vacancies in the press mention that the remuneration will be not less than that of the B.A.C. Scales.

Membership.—One hundred and twenty new members were elected during the year.

Unemployment Benefit Fund.—It was decided that bonuses of up to 5s. per unit per week should be added where appropriate to the basic rate of Unemployment Benefit of £1. 2s. 0d. per unit per week during 1959/60. During 1958/59 Unemployment Benefit totalling £462 had been paid to members. The sum of £384 had been returned to contributors to the U.B.F. who had retired, or to the estates of those who had died.

The award of the Association's *Hinchley Medal* for meritorious services to chemistry was to be made to *Mr. L. E. Puddefoot*, B.Sc.

ANNUAL DINNER 1959

The Annual Dinner of the British Association of Chemists was held this year at the Midland Hotel, New Street, Birmingham on Friday, December 12, 1959. The guests were received by the President, Mr. J. Wilson and Mrs. Wilson.

Mr. E. G. K. Pritchett, B.Sc., F.R.I.C., Chairman of the Birmingham Section of the Royal Institute of Chemistry proposed the toast of 'The B.A.C.' He said he was very gratified that a Chemical Association had chosen Birmingham to hold their Annual Dinner as Birmingham was one of the centres in the chemical industry. He went on to say that the B.A.C. was one of the two major Chemical Associations dealing with professional men in chemistry and gave a great deal of help in dealing with unreasonable employers for their members and also in dealing with the professional status of chemists, individual chemists however should keep up to date in modern chemistry and younger members should be more interested. For many years the B.A.C. had been looking after the interests of young chemists and the recent discussions with regard to the formation of a new organization to cover young people who did not quite reach graduation standard in chemistry should be of very great help to them. Mr. Pritchett felt sure that the B.A.C. would function very well in this respect.

Mr. Wilson, the President, responded and thanked Mr. Pritchett for proposing this toast. He said it gave him particular pleasure to respond as 30 years ago he belonged to several associations in Birmingham and in no other town where he had worked had there been more harmonious relations between the various associations. He went on to say that the B.A.C. had been in existence for 42 years and had some very distinguished founder members. Fewer professional people today feel the need for the protection of a Trade Union. But where help was needed, in many cases only the B.A.C. could give it. Blackspots had arisen in various nationalized industries where chemists were not represented on the negotiating bodies. In relation to the gas industry, the B.A.C. had done a great deal of work in the past two years. The President went on to speak about the great interest which had been aroused in the proposed formation of an Institute of Chemical Technology and said that he had been overwhelmed by the financial support which members had given to this project. If it went forward, the B.A.C. had only to tap these resources to become one of the most influential Associations in the country. He very much appreciated the kind way Mr. Pritchett had toasted the B.A.C. and it gave him very much pleasure to reply.

Mr. C. H. Bowyer, B.Sc., A.C.I.P.A., F.R.I.C., the Chairman of the Birmingham Section of the B.A.C. then proposed the toast of 'Our Guests'.

Mr. F. A. Jones, B.Sc., F.I.R.I., F.P.I., F.R.I.C., Chairman of the Birmingham Section of the Society of Chemical Industry then rose to reply on behalf of the guests and he mentioned that he could remember the B.A.C. being founded in 1917. He said that all chemists spoke a common language despite the very many different branches of chemistry in these days, but the B.A.C. covered all these branches and it gave him great pleasure to reply to Mr. Bowyer's toast. On behalf of himself and the other guests he expressed great appreciation of the hospitality which the members of the B.A.C. had so kindly extended to them.

All correspondence and enquiries concerning this Association should be addressed to G. R. Langdale, Esq., The British Association of Chemists, Nomination Dept., 14 Harley Street, London, W.1. Tel.: Museum 7021.

Laboratory Note-Book

THE past 12 months have witnessed a tremendous endeavour on the part of Western governments, research associations, information centres and publishers to make available to English-speaking research workers the increasing spate of scientific and technical literature which is being published in the U.S.S.R. Both the British and American governments have set up clearing houses which publish guides to sources of Russian information, and sponsor cover-to-cover translations of all the important Russian technical journals.

Many projects—some ambitious, some more modest—have been initiated by non-governmental organizations to deal with the more specialized sources of Russian information.

Russian Patents Gazette published by Technical Information Company (Chancery House, Chancery Lane, London, W.C.2,) has been accepted as the English-language medium for keeping abreast of newly-published Russian patents (*Opisanie Izobretenii*).

Concise abstracts are arranged under convenient subject headings which enable the user very rapidly to locate those items which interest him. They also facilitate retrospective searches through the records of earlier patents.

Copies of the original Russian patents, and special low-cost translations into English are available from the publishers.

University Laboratory Technicians

The Industrial Court has awarded pay rises to some 5,000 technicians who do scientific work behind the scenes in University laboratories. These range from £16 a year for a junior aged 16 to £115 for a chief technician at his maximum. The increases date from October 1 last.

Mr. John Dutton, general secretary of the Association of Scientific Workers, when announcing the award said that 16 universities and university colleges in England, five in Wales and four in Scotland had agreed to abide by the award.

New pay rates will be: junior, £210 rising to £400 at 23; technician (21-28), £540 to £615; senior technician, £640 to £740; chief technician, £825 to £925 (in special cases, £1,050).

Hey Presto for Dr. Presto

On Friday, November 13, a trans-Atlantic telephone call was received at the works of Winston Electronics, Ltd., from Dr. A. Presto of the Leonard Surgical Company, New York, requesting the immediate delivery of a Winston-Green blood pressure follower equipment. The reaction in the U.S.A. after the equipment was announced to the Press on October 13 has been so excellent that over 50 major hospitals in the United States are urgently demanding to view and have the equipment demonstrated.

This, the first of this type of equipment to go to America, left the works of Winston Electronics on Tuesday, November 17, and arrived in New York on the same day.

The Winston-Green blood pressure follower is an electronic-pneumatic system, which records and controls human blood pressure continuously for as long a period as may be desired without danger or discomfort to the patient, and is for use in all branches of medicine and surgery where blood pressure readings are required. It also controls automatically the flow of hypo- and hyper-sensitive drugs into a patient in order to maintain automatically the blood pressure within prescribed limits.

Success of Basle Exhibition

The first of its kind to be held in Switzerland, the International Congress and Exhibition of Laboratory, Measurement and Automation Techniques in Chemistry, which took place at Basle from November 10 to 15, 1959 in the Swiss Industries Fair Building, was a great success.

There were no fewer than 292 exhibitors from 11 countries taking part in the Exhibition, which was visited by some 14,000 prospective customers from all parts of Europe as well as overseas. Conversations with the exhibitors and a written questionnaire have shown that their expectations were not only fulfilled but in many cases greatly exceeded.

Some 1,200 specialists from every country in Europe attended the Congress organized by the Swiss Association of Chemists and the Swiss Association for Automation. In addition to the scientific and technical problems of laboratory and measurement techniques and automatic control in chemistry, to which the papers of the first three days were devoted, the economic aspects of automation and questions of data processing in business were discussed during the last two days.

Radio Research

The Council for Scientific and Industrial Research has authorized changes in the terms of reference of the Radio Research Station, D.S.I.R., and has appointed Mr. J. A. Ratcliffe, C.B.E., F.R.S., to be the new Director from October 1, 1960 when the present Director, Dr. R. L. Smith-Rose, C.B.E., retires.

The Radio Research Station has earned for itself an international reputation for its detailed studies of the propagation of radio waves by way of the ionosphere and the troposphere. Recently the programme has been reviewed and its scope has been extended so as to take advantage of the new techniques provided by rockets and artificial earth satellites.

Under its new terms of reference the Station will undertake investigations of the upper atmosphere and outer space by both radio and non-radio methods. Half the total staff effort of the Station (amounting to about 80 scientists and assistants) will be made available for this purpose. The necessary additional staff is being recruited.

Mr. L. A. Woodhead, President of the Scientific Instrument Manufacturers Association of Great Britain, with the delegates of the Association's team at London Airport on their departure to Moscow to discuss, at the invitation of the Russian All-Union Chamber of Commerce, the possibilities of an exhibition of British scientific instruments in Moscow during the summer.

LABORATORY EQUIPMENT & APPLIANCES

Polytetrafluoroethylene

Polytetrafluoroethylene is the most chemically resistant material from which laboratory ware is now being produced. It can be used at temperatures from —265° to + 315° C. It is inert, even at elevated temperatures, to practically all chemicals except fused alkali metals, and fluorine and chlorine trifluoride at elevated temperature and pressure. Ware made from this tough, white plastic is practically indestructible in ordinary use. Excellent durability has been indicated by accelerated ageing tests, including heating for prolonged periods at 315° C. and continuous outdoor weathering, which has had no discernible effect on samples of the material exposed for over ten years.

The plastic is easy to clean and has excellent pouring characteristics, as its smooth, waxy surface repels water, and most materials do not adhere to it. It has extremely low coefficient of friction and resists wear in such applications as magnetic stirring bars and homogenizer pestles. The surface can be marked readily with usual glass marking pencil, and its slight translucence permits observation of liquid level if vessel is illuminated from behind. Density is approximately 2·2.

When heated above 260° C., it is recommended that Polytetrafluoroethylene be used under a hood or in a well ventilated area, as traces of the polytetrafluoroethylene monomer may be given off. The plastic changes to a transparent gel above 325° C., and significant decomposition occurs above 400° C. Although the material is non-inflammable, uniform application of heat and avoidance of open flame heating are recommended. Vessels can be heated by means of ovens, baths, heating tapes, heating mantles, and hot plates with protective asbestos pad, provided the temperature of the plastic is not allowed to exceed 315° C.

Polytetrafluoroethylene ware can be sterilized thermally or chemically. The use of abrasive cleaners should be avoided, to prevent scratching of the smooth surface.

(Manufacturers: X-Lon Products, X-Lon House, 48 Gillingham Street, S.W.1.)

Laboratory ware in polytetrafluoroethylene.

Oxygen Analyser

The D2 oxygen analyser, for safe oxygen therapy, can be used for incubators, oxygen tents, masks, in surgery, in the nursery and in the hospital or sickroom.

It provides an accurate reading to within ± 2 per cent and gives per cent oxygen concentration in 10 seconds.

To make a reading, the bulb is squeezed to draw a gas sample into the instrument, a button is pressed and the oxygen percentage is noted on an easy-to-read scale.

The D2 oxygen analyser for medical and other applications.

It also has non-medical applications and can be used in the analysis of flue gas, oxygen concentration in welding atmospheres, purge lines and inert gas blankets.

(Manufacturers: Beckman Instruments Ltd., Glenrothes, Fife.)

New Multi-Speed Stirrer

A new, more powerful stirrer which should find many uses in almost every type of laboratory, is now available. It has a 1/30th h.p. cool running motor with a speed range up to 7,000 r.p.m., designed with the special speed/torque characteristics desirable in a stirrer and for other laboratory applications. The stall current does not exceed the running current, thus reducing any tendency to overheat.

Speed control is by means of a special choke-transformer and there is no heat loss, as occurs when a rheostat is used. Two patterns of control are available. The Mark I with 10 speed settings from 700 to 7,000 r.p.m., and the Mark II with 100 settings over this range. The Mark II control is fitted with a safety fuse to protect against any mechanical damage to the wiring, etc.

The speed control units are connected to the motor by two yards of cable, making the unit particularly suitable for fume cupboard applications.

A gear box with 11 to 1 ratio is fitted when required, and gives a very powerful drive at a speed range of 60-600 r.p.m.

The Multi-speed stirrer is compact and finished in silver grey stove enamel. Standard voltages are 230-250 volts A.C. 50 cycles single phase and 115 volts A.C. 50 cycle single phase.

(Manufacturers: J. W. Towers & Co., Ltd., Widnes, Lancs.)

NEWS

General

Linear and Non-linear Servo Control Systems

A short course of ten lectures to be given by J. Sands, B.Sc.(Eng.), on Wednesday evenings, from 7 to 9 p.m., commencing January 20, 1960, will be held at the South East London Technical College, Lewisham Way, S.E.4. (Fee £1.)

The object of the course is to give a brief but comprehensive introduction to the principles of control engineering.

(*a*) Linear systems—five lectures—Definitions. Open and closed loop control. Transient and frequency response. Stability, design methods.

(*b*) Non-linear elements and control systems—five lectures—Types of non-linearity. Function analysis. Phase plane analysis. Analogue simulation of control systems.

Enrolment may be made by personal attendance at the College 6.30-7.30 p.m. any evening after January 15, 1960, or by post providing the fee is enclosed and the following information supplied: (1) name and address of student, (2) name and address of employers.

Micro- and Semi-Microchemical Methods

Commencing January 9, 1960, a course of 12 lectures and appropriate practical work will be held on Saturday mornings at the Norwood Technical College, London, S.E.27, from 9.15 a.m. to 12.30 p.m.

This course is particularly suitable for teachers and industrial and research chemists. The course is designed to survey the principal branches of chemistry in which small-scale methods have been successfully applied.

Lectures, illustrated by demonstrations, will deal with the following topics: Scope; aim and achievements of small-scale techniques; design and construction of simple apparatus; organic and inorganic preparations on the reduced scale; simple chemical microscopy and photomicrography; inorganic qualitative analysis; organic qualitative and quantitative analysis; physicochemical-methods of analysis; chromatography; small-scale techniques for the determination of molecular weight, etc.

In the main, apparatus either easily constructed or normally at hand will be used, as the course is of an essentially practical nature.

Application forms for admittance to the course may be obtained from the Secretary of the College. The London fee for the course is £1.

New £750,000 Research Centre

A new biological research centre which cost £750,000 to build and equip was recently opened in Nottingham by Boots Pure Drug Co. Ltd. The seven-storey building with its 24 laboratories will provide the most up-to-date facilities in Britain for research in pharmacology and chemotherapy and for analytical and control work in the bio-assay and microbiology divisions of the company's standards department.

The erection of this new biological centre is part of a general programme of modernization and expansion of the company's research facilities. Medical research at Boots has been expanding rapidly in the years since the war and within the last three years alone there has been an increase of 25 per cent in graduate staff engaged in this work. Space has been allowed in the new building for a further increase of 50 per cent.

The building also houses the company's scientific library of 25,000 volumes, believed to be the largest owned by any pharmaceutical company in Great Britain, and includes a new lecture theatre to seat 200. An up-to-date feature in the laboratories is a radioactive isotope unit which will give Boots scientists greatly improved scope for the study of the movement of drugs in the body. In addition to increased space and new equipment, many advantages will be gained from housing under one roof related work that has previously been scattered. Administrative offices of Dr. G. I. Hobday, Boots director in charge of all branches of research, are also to be found within the building, as is the medical department which is responsible for the clinical evaluation of new drugs and products and for liaison between research scientists in the laboratory and clinicians at home and abroad.

It is hoped that the facilities now available will give new impetus to the company's research into certain specific infectious diseases, including tuberculosis, influenza and the common cold and to their long-term investigations into rheumatism, diabetes and coronary heart disease.

In the new building investigations will also be carried out into possible new treatments for tropical diseases, a field in which the company has specialized. Research involving antibiotics will be linked with the work of the specialist laboratory opened in 1956 on the site of the antibiotics factory on the outskirts of Nottingham.

Sturge Open New Research Laboratories

New laboratories for organic and biochemical research work have been opened at Wheeleys Road, Birmingham, by John & E. Sturge Ltd., as part of a £100,000 research and development programme, and an overall plan to centralize the company's research work.

One of the main activities will be fundamental research on fermentation problems, particularly in connection with the microbiological production of citric acid, involving a close study of the biochemical and chemical aspects of the life cycle of *Aspergillus Niger* and the undertaking of an extensive mutation programme.

The well-equipped laboratories in-

Boots new £750,000 biological research centre.

clude an instrument room which is maintained at a constant temperature of 20° C., a special cold room for enzyme manipulation in which the temperature can be kept down to 0° C. indefinitely, and sterile air conditioned rooms to facilitate the handling of micro-organisms.

The existing physical chemistry research laboratories at Wheeleys Road have been modernized, and are now fully-equipped for radiochemical and high vacuum work and for ultra violet spectroscopy.

At the company's Lifford Chemical Works, Birmingham, the analytical laboratories are being extended to cope with the testing of increased production and the development laboratories have been rehoused in larger premises and now include a section for technical service work on rubber, plastics, paper, paint and printing inks.

The Yorkshire laboratories at the company's Selby works—formerly devoted to the organic and biochemical research work—are now being used to extend the facilities of the development, analytical and microbiological departments. Construction work will start shortly on a new fully-equipped pilot plant, together with an associated laboratory and administrative offices.

Manufacturers' News

British Equipment at Basle Exhibition

Among the items of laboratory equipment exhibited by Isotope Developments Ltd., at the International Exhibition of Laboratory Measurement and Automation Techniques in Chemistry, held in Basle recently were:

Scaler, type 1700.—A novel type of counting equipment for radioactivity measurements, in that it embodies all the functions required of a complete counting unit in one instrument case and also employs the very latest construction techniques to give reliability and extreme simplicity of service and maintenance. The unit includes an automatic scaler with pre-set count facilities, an automatic timer with pre-set time facilities, a high voltage supply, a pulse amplifier, a discriminator, a single channel pulse height analyser and a ratemeter. The complete unit is a single bench mounting instrument, but can also be mounted in a standard instrument rack with other units if required.

'1800' *series.*—This is a series of separate instruments designed for radioactivity measurements, employing the printed circuit plug-in features which were originally designed for the scaler, type 1700 above. The instruments in this range are low priced, space saving units which can be bench mounted in their cabinets or occupy 5¼ in. of height in a standard 19 in. rack.

The range includes the scaler, type 1800, the high voltage supply, type 1820, the amplifier selector, type 1830, the prescaler, type 1850, the ratemeter, type 1810, and these will be followed by a number of other equipments still under development.

Bench Mounting Scintillation Counter, type 722.—This is a lead shielded gamma ray detector for measuring radioactive samples. It can be used with a well-type phosphor for samples of very small volume, or with a normal sodium iodide crystal for measuring samples up to 1 litre in volume. It finds application in all types of radiation laboratories for medical studies, metallurgical tracer studies, etc.

Scintillation Counter, type 661.—This is a slim scintillation probe for gamma ray measurements where a unit is required for easy manipulation by hand. It can be supplied with a simple set of removable lead collimators, handles and mounting brackets, and can be operated in conjunction with the 1700 or units of the '1800' series.

★

E-MIL laboratory glassware and thermometers were exhibited at the first International exhibition of Laboratory Equipment at the I.L.M.A.C. exhibition, Basle, Switzerland, from November 10-15.

The E-MIL exhibit formed a prominent part of the display put on by H. J. Elliott Ltd.'s principal stockist and distributor in Switzerland, Martin Jaeger, Vesenaz, Geneva.

Mr. Stanley H. Elliott, Managing Director of H. J. Elliott Ltd., also attended the exhibition.

Elga Celebrate Move to Lane End

Some 50 research workers from universities and technical colleges, doctors, pharmacists, teachers, and members of industry, attended a house warming party at the new headquarters of Elga Products Ltd. at Lane End, Bucks. The Ion Exchange Regeneration Division created most interest and visitors saw the sequence of operations and the principles of procedure upon which the Elgastat cartridge service is based.

Calling Ex-Apprentices

Laurence, Scott & Electromotors Ltd. would like to hear from ex-apprentices with whom they have lost touch. It is hoped to arrange for a get-together, possible during the run of the Electrical Engineers Exhibition.

Ex-apprentices are asked to give details of their present whereabouts, either to Mr. W. F. Symes at Gothic Works, Norwich, or by telephone to Mr. T. J. Barfield at Temple Bar 5223.

Cardiff Exhibition

A two-day exhibition of laboratory furnishings, scientific apparatus, chemicals and glassware was staged at the Queen's Hotel, Cardiff during October by T. W. McCarthy & Sons, laboratory furnishers.

Firms represented were: Quickfit & Quartz, Hudes Merchandising, Elliotts, May & Baker, R. & L. Enterprises, and Electro-Thermal Equipment.

The exhibition was well attended and great interest was shown in the exhibits. It is hoped to plan further exhibitions of this nature in the South Wales area.

Gallenkamp/Towers

An Agreement was completed and signed on November 3 whereby A. Gallenkamp & Co. Ltd., acquired the business of J. W. Towers & Co. Ltd. by the purchase of all the Ordinary shares.

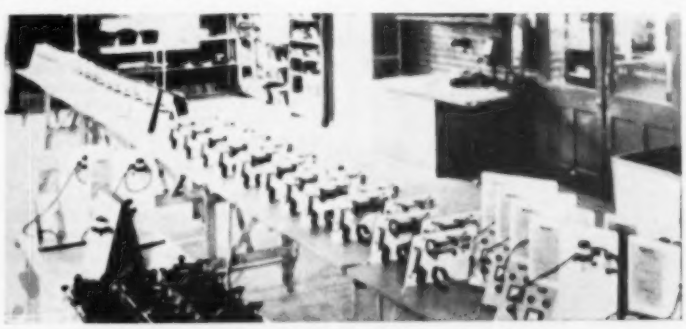
The elected new Board of Directors is:

Mr. A. W. A. Rundle (Chairman)
Mr. J. S. Towers
Mr. J. P. Oldfield
Mr. H. F. Kirby

Mr. J. S. Towers, to assist smooth coordination, held office as Managing Director until December 31, 1959, and thereafter Mr. J. P. Oldfield has accepted the appointment of Managing Director. Mr. H. Ditchfield has been appointed Company Secretary.

New Datum Factory

In order to cope with the steady increase in business that has resulted from the policy of expansion initiated at the beginning of 1959, Datum Metal Products Ltd. have moved into a new and



The production line at Elga Products new headquarters.

larger factory on the Colne Way Trading Estate, Watford By-Pass. These new premises have trebled the productive area of the factory. The new workshops are laid out on the most modern lines and are equipped with some of the latest examples of metal working machinery.

A new office block is nearing completion, and this will house the sales and administrative staff.

The new address is now Datum Metal Products Ltd., Colne Way Trading Estate, The By-Pass, Watford, Hertfordshire, and the new telephone number is WATford 22351.

Personal Notes

Mr. J. A. Balchin

Mr. J. A. Balchin, B.Sc., A.Inst.P. has been appointed Head of the Health Physics Division of Electronic Instruments Ltd., of Richmond, Surrey. Mr. Balchin has just completed four years as a senior physicist with the Liverpool Radium Institute and has over eight years experience as a hospital physicist, as well as a period of some years in the field of industrial research.

Mr. John Glover

Mr. John Glover has recently joined Astell Laboratory Service Co. Ltd. as an additional Director. Until he relinquished the post to take up his new position, he was National Chief Milk Chemist for the C.W.S. Ltd.

Mr. R. E. Burnett

Mr. R. E. Burnett, M.A. (Oxon.), A.M.I.E.E A.Inst.P., General Manager of Marconi Instruments Ltd., has been elected to the Board, and appointed Managing Director of the company.

Mr. Burnett graduated at Oxford University in 1937 with an honours degree in physics. He subsequently qualified as a chartered electrical engineer and as an associate of the institute of Physics. In 1955 he studied business management in the department of business administration at Columbia University, New York, followed by a study tour of various manufacturing establishments in the U.S.A.

Mr. Burnett was appointed General Manager of Marconi Instruments in 1956, having previously occupied the position of Deputy General Manager.

Before joining Marconi Instruments, Mr. Burnett was Assistant to the General Manager of Marconi's Wireless Telegraph Co. Ltd. His appointments with that Company included Principal of Marconi College and Manager of the Education and Technical Personnel Departments.

Mr. R. E. Burnett.

Mr. G. C. Devereux.

Mr. G. C. Devereux

Mr. G. C. Devereux, Manager of the Technical and Development Divisions of H. J. Elliott Ltd., completed 41 years with the company in December. In 1958, his fortieth anniversary of service in the company was marked by the presentation of a gold wristlet watch and a pair of binoculars. Recently, Mr. Devereux, as a member of the United Kingdom delegation, has been attending the International Standards Organization meetings on the subject of laboratory glassware and related apparatus, in London, at the British Standards Institution.

Dr. Charles E. Dalgliesh

Dr. Charles E. Dalgliesh, M.A., Ph.D., Sc.D., has been appointed to the Board of Directors of Miles Laboratories Ltd.

As Research Director, Dr. Dalgliesh will head a new research division which the company is forming in Great Britain. This division will set up the Miles-Ames Research Laboratories which will constitute a major research centre for the Miles group of companies—a worldwide organization of which the parent company is Miles Laboratories Inc., with its own Research Laboratories at Elkhart, Indiana, U.S.A. This is the first time this Organization has set up a basic research centre outside the American Continent.

Miles Laboratories Ltd. further announces that it has purchased Stoke Court, Stoke Poges in Buckinghamshire. This is an old country mansion of historic interest in which, after restoration and conversion, it is planned to establish the new Research Division and Laboratories. It will also house the Headquarter Offices of the company, together with the sales and administration departments. The work of restoration is already going ahead, and it is expected that the new headquarters will be ready for occupation next summer.

Publications

British Chemicals

The 1959 edition of 'British Chemicals and their Manufacturers' has now been published by the Association of British Chemical Manufacturers. This edition is an extension of previous publications in the series and contains over 12,000 products named systematically and in accordance with British Standard 2474: 1954—Recommended Names for Chemicals Used in Industry.

Copies of this useful book (207 pages) are available free of charge to all persons or firms genuinely interested in the manufacture or purchase of chemicals and all enquiries about it should be addressed to the Association at Cecil Chambers, 86 Strand, London, W.C.2. (Tel.: Covent Garden 2363.)

Scientific and Technical Conferences

An addendum to List No. 25 (covering the period October 1959 to January 1960) of Forthcoming International Scientific and Technical Conferences, published by the Department of Scientific and Industrial Research, amends and brings up to date the information contained in List No. 25.

Unilever Research

Unilever Ltd. have produced an interesting and stimulating booklet entitled 'Unilever Research' which tells the student something about research work in Unilever so as to attract good scientists to their laboratories. In it the student will find answers to such questions as: What are the satisfactions of industrial research as distinct from academic research? How are the results of fundamental research followed through product development to factory processes? What openings can a graduate expect through these streams as well as in the realm of research?

Ion Exchange Resins

The fourth edition of 'Ion Exchange Resins' has now been published by The British Drug Houses Ltd., of Poole, Dorset.

This completely revised edition contains full details of all resins in the Amberlite and Permutit ranges, including the analytical and chromatographic grade resins. Tables give details of the physical properties of the various types. The section on applications has been revised and extended and now includes details of some of the newer advances in resin technology, e.g. preparation of 'selective' resins, ion exchange chromatography, ion exclusion, applications of ion exchange membranes.

The book concludes with a table listing the potential and recommended applications of the various resins, a bibliography of books and review papers for further reading, and a subject index.

Opportunities for Graduates

The 1960 edition of 'The Directory of Opportunities for Graduates' (p. 248, price 8s. 6d.) has now been published by the Cornmarket Press Ltd. In this, 275 organizations now give details of the careers they offer to university graduates —an increase of 50 per cent on the first national edition published in 1957.

It is the aim of the Directory to ease the flow of graduates from university to industry by providing the graduating student with up-to-date information about the firms which need him and the opportunities open to him.

The publishers will also shortly be publishing 'Canada Careers Directory' which will also give the same service for students and industry in Canada. It, too, will contain details of leading Canadian industrial organizations and government agencies.

CATALOGUES, BROCHURES & LEAFLETS

Received from Manufacturers

New Products and Price Reductions.—A leaflet describing six new products (nesting beakers, bottle carriers, mercury collectors, test tube racks, rigid polythene scoops, and bottle trays) has been published by the Loughborough Glass Co., Ltd., of Loughborough, Leicestershire. Details of price reductions for polythene carboys and non-return valves are also included in this leaflet.

Instruments for Fine Measurement.—A standard catalogue and some new leaflets describing a series of new instruments for fine measurement have been issued by Paton Hawksley of Rockhill Laboratories, Keynsham, Bristol. These instruments can cover up to 4 ft. conveniently and given a suitable surface plate 4 ft. sections can be stacked lengthwise indefinitely.

Laboratory Service.—W. Markes & Co., Ltd., of Wolverhampton Road, Wedges Mills, Cannock, Staffs., have issued a catalogue giving details of taps, cocks and valves for water, gas, steam, compressed air and vacuum services in the modern teaching, research and industrial laboratory. It is not the company's policy to sell direct to the user, but through the recognized laboratory furnishers and other established wholesale channels and firms directly connected with the building of the laboratory.

More Reagents for Research.—L. Light & Co. Ltd. of Colnbrook, Bucks, have just issued their 1960 catalogue of over 5,000 substances which embrace organic chemicals for syntheses, biochemicals, enzymes and analytical reagents. Since their 1958 list the range has been increased by 1,000 items, thus keeping pace with the latest developments in many scientific fields. Particular emphasis has been placed on the manufacture of chromatographically pure laevo-amino acids and peptides. Rare alkaloids and phytochemicals have also engaged their attention.

B.D.H. Leaflets.—New entries in the catalogue of British Drug Houses Ltd., of Poole, Dorset, are listed in the December issue of their monthly leaflet. These are as follows: *Organic and Inorganic Chemicals.*—Butylated hydroxyanisole; carbon disulphide for infra-red spectroscopy: *n*-dodecyl gallate; *n*-octyl gallate; potassium borohydride; 'Union Carbide' molecular sieves. *Wetting Agents.*—Hyamine 2389.

Amino-Acid Analysis.—Data sheet from Oxford Laboratories, 961 Woodside Road, Redwood City, California, describes a new amino-acid-analysis service available from the Analytical Division. Six points cover the general outlines of the service available and a list of appropriate references is included. The sheet also covers general data on the proper quantity and forms for materials being sent in for analysis. Preparative steps available in the division are also discussed. Among the specimens being handled are: purified proteins, purified peptides, plasma, tissues, urine, and foods. The data sheet is identified as Form V1959.

Labacta Brochure.—J. W. Towers & Co. Ltd., of Victoria House, Widnes have published a brochure about Labacta, which may be defined as a universal nutrient base. Its nutritive properties are specially potent in the culture of pathogenic micro-organisms. Labacta can be offered as a ready to use nutrient agar-blood agar base, and also as a nutrient broth.

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MEETINGS OF THE MONTH

Mid-January to Mid-February

We give below a selection of meetings of interest to laboratory workers. Details are as full as possible at the time of going to press, but readers requiring further information or confirmation of arrangements should contact the organizers.

January 8

The Society for Analytical Chemistry (Western Section). At Bristol. Annual General Meeting followed by a Joint Meeting with the Bristol and District Section of the R.I.C. on 'Radiochemical Analysis.'

The Society for Analytical Chemistry (Scottish Section). At Royal Society of Edinburgh, 22 George Street, Edinburgh 2. 7.15 p.m. 'Infra-red Spectroscopy', by L. J. Bellamy and D. M. W. Anderson, B.Sc., Ph.D., A.R.I.C.

The Society of Instrument Technology (Fawley Section). At the Administration Building, Esso Refinery, Fawley. 5.30 p.m. 'Quality Control', by Dr. Millership.

The Chemical Society (Edinburgh Section). At the North British Station Hotel, Edinburgh. 7.30 p.m. 'Chemistry Applied to Criminal Investigation', by Detective Chief Inspector J. K. McLellan.

January 12

The Society for Analytical Chemistry (Midlands Section). At the University, Birmingham 3. 6.30 p.m. 'Modern Methods of Micro-gas Analysis,' by G. J. Minkoff, D.Sc., D.I.C.

The Society for Analytical Chemistry (Microchemistry Group). In Birmingham. 6.30 p.m. Joint meeting with the Midlands Section of the Society.

The Chemical Society (St. Andrews and Dundee Section). In the Chemistry Dept., Queen's College, Dundee. 5 p.m. 'The Chemical Contribution to Cancer Research', by Prof. A. Haddow, F.R.S.

January 14

The Chemical Society (London Section). In the Lecture Theatre, The Royal Institution, Albermarle Street, W.1. 7.30 p.m. 'Progress in the Study of Heterogeneous Catalysis', by Prof. C. Kemball, M.A., Ph.D., F.R.I.C.

The Society of Instrument Technology (South Yorkshire Section). At the John Leggot Grammar School, Coal Street, Scunthorpe, 7.30 p.m. 'Automatic Analytical Instruments', by G. H. Moss.

January 15

The Chemical Society (Birmingham Section). In the Large Chemistry Lecture Theatre, The University, Birmingham. 4.30 p.m. 'Alkali Metal Derivatives of Organic and Organometallic Compounds', by Prof. G. E. Coates.

The Chemical Society (St. Andrews & Dundee Section). At the Chemistry Dept., St. Salvator's College, St. Andrews. 5.15 p.m. 'Some Effects of Remotely Placed Groups upon Reactions of Organic Molecules', by Prof. H. B. Henbest, Ph.D., A.R.C.S., A.R.I.C.

January 18

The Chemical Society (Cambridge Section). At the University Chemical Laboratory, Lensfield Road, Cambridge. 5 p.m. 'Chelatometry', by Dr. T. S. West.

January 19

The Chemical Society (Cambridge Section). At the University Chemical Laboratory, Lensfield Road, Cambridge. 11.30 a.m. 'The Analysis of Microgram Amounts of Organic Compounds', by Dr. T. S. West.

January 20

The Society for Analytical Chemistry (Biological Methods Group). In the Meeting Room of the Chemical Society, Burlington House, London, W.1. 7 p.m. 'Antibiotic Assay in Body Fluids', by Prof. L. Garrod, M.A., M.D., F.R.C.P.

January 21

The Society of Instrument Technology (East Midland Section). At the College of Technology and Commerce, The Newarke, Leicester. 6.45 p.m. 'Instrument Research at Stewarts & Lloyds', by M. J. Hetherington.

January 22

The Chemical Society (Glasgow Section). Chemistry Dept., Glasgow University. 4 p.m. 'Energy Transfer in Gases', by Prof. T. L. Cottrell.

January 25

The Society of Instrument Technology (Bristol Section). In the University of Bristol, Dept of Physics, The Royal Fort, Bristol 8. 7.30 p.m. 'Transistors in Instrumentation'.

The Chemical Society (Cardiff Section). In the Chemistry Dept., University College, Cathays Park. 5.30 p.m. 'Some Models of Physical Adsorption', by Prof. D. H. Everett, M.B.E.

The Chemical Society (Durham Section). In the Science Laboratories, Durham University. 5 p.m. 'Reactions in Liquid Dinitrogen Tetroxide', by Dr. C. C. Addison, F.Inst.P., F.R.I.C.

January 26

The Chemical Society (Nottingham Section). In the Chemistry Dept., The University, Nottingham. 8 p.m. 'Hydrocarbon Metal Carbonyls', by Prof. P. L. Pauson.

The Chemical Society (Northern Ireland Section). In the Dept. of Chemistry, Queen's University, Belfast. 7.45 p.m. 'Electron Resonance of Free Radicals', by Dr. D. H. Whiffen, M.A.

January 28

The Chemical Society (N. Wales Section). In the Dept. of Chemistry, University College of North Wales. 5.45 p.m. 'Synthesis and Dissolution of Starch in Plants', by Prof. Helen D. Porter, D.Sc., F.R.S.

The Chemical Society (Liverpool Section). In the Dept. of Inorganic and Physical Chemistry, The University of Liverpool. 5 p.m. 'Progress in the Study of Heterogeneous Catalysis', by Prof. C. Kemball, Ph.D., F.R.I.C.

January 29

The Society for Analytical Chemistry (Scottish Section). At Glasgow. 1.30 p.m. Annual General Meeting, followed by an address by D. W. Kent-Jones, B.Sc., Ph.D., F.R.I.C.

The Chemical Society (Cambridge Section). In the University Chemical Laboratory Lensfield Road, Cambridge. 8.30 p.m. 'The Structure of Myoglobin', by Dr. J. C. Kendrew, M.A.

The Chemical Society (Newcastle Section). In the Chemistry Dept., Kings College. 5.30 p.m. 'Activation of Carbon-Carbon Double Bonds by Cationic Catalysts', by Prof. A. G. Evans. Ph.D., D.Sc.

January 30

The Society for Analytical Chemistry (North of England Section). At the Nags Head Hotel, Lloyd Street, Manchester. 2.15 p.m. Annual General Meeting and Meeting on 'Analytical Methods in Clinical Biochemistry', by H. Varley, M.Sc., F.R.I.C.

CORRECTION

In the December 1959 issue of *Laboratory Practice* under 'Manufacturers' News' (p. 430) reference was made to the Southern Instrument's mobile demonstration unit, and its first journey to Scotland.

We should like to point out that Elesco Electronics Ltd. are the Scottish agents of the Recording and Data Handling Department and the Industrial Department, but *not* the Scottish agents of Southern Instruments Ltd. The Scottish agents of the Analytical Instruments Department are A. R. Bolton & Co. of Edinburgh.

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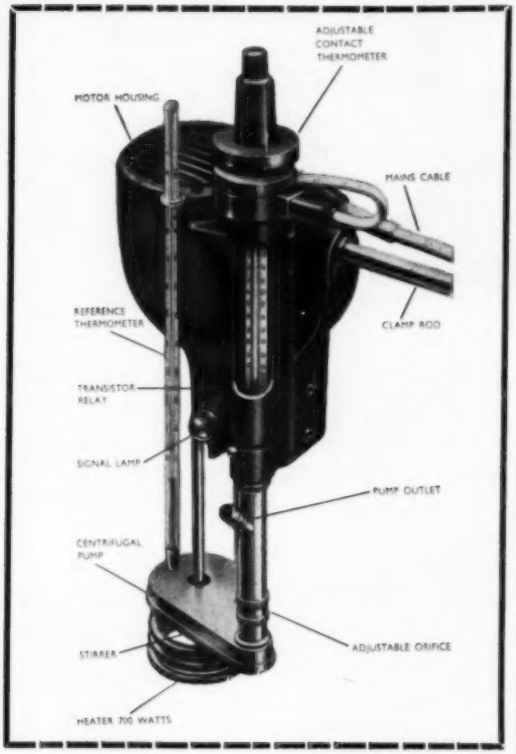

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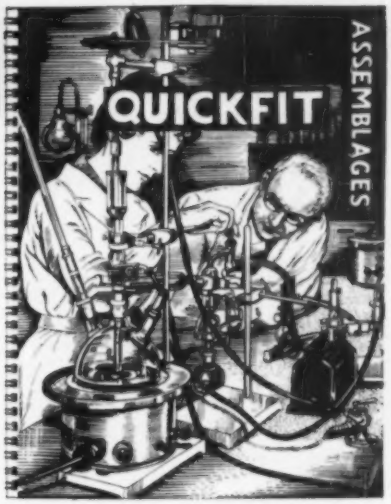

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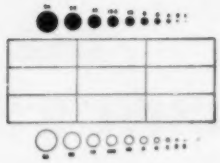
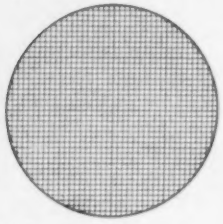
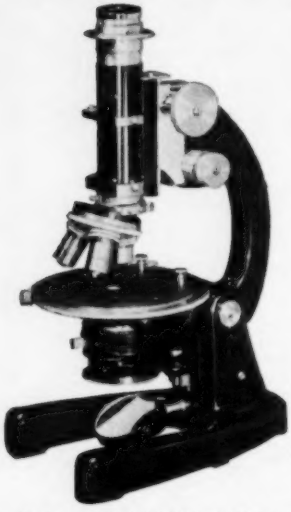
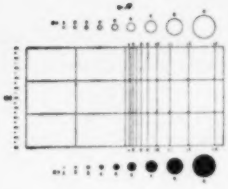
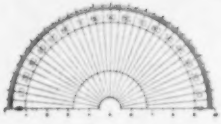
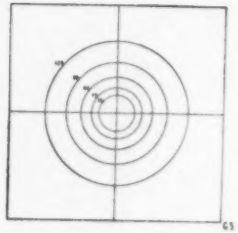

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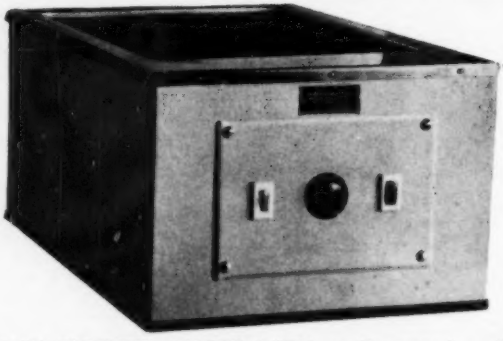

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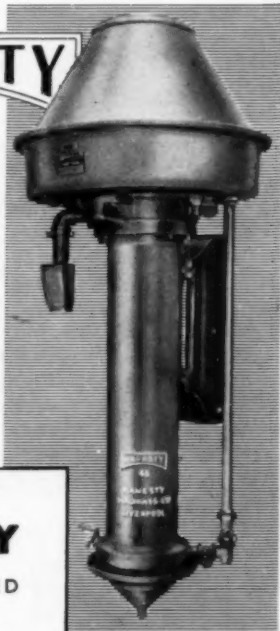

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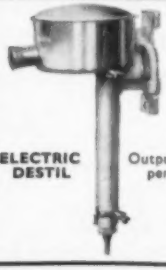

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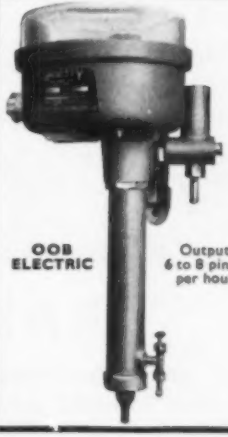

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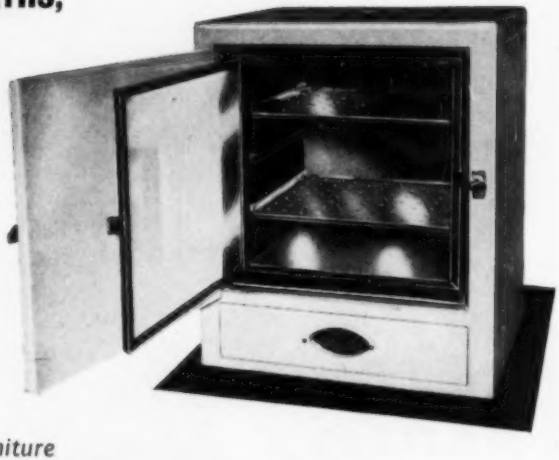

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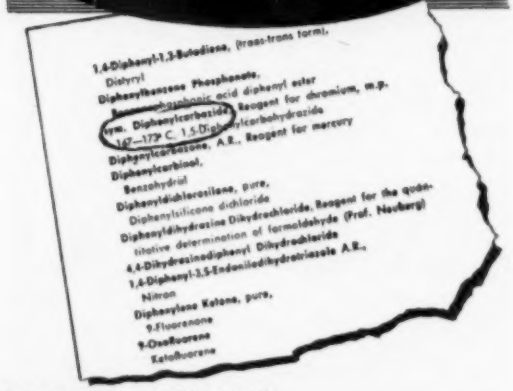

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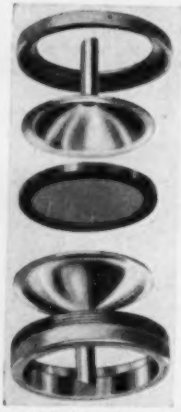

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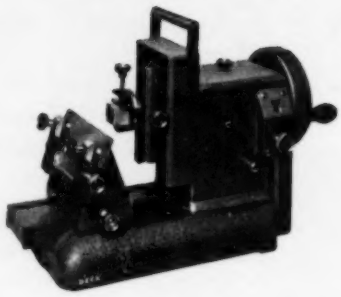

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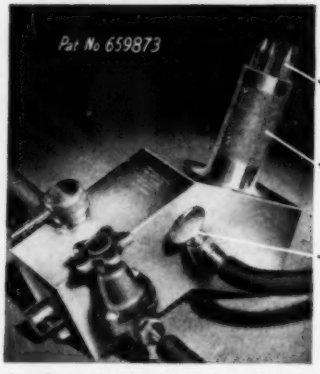

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